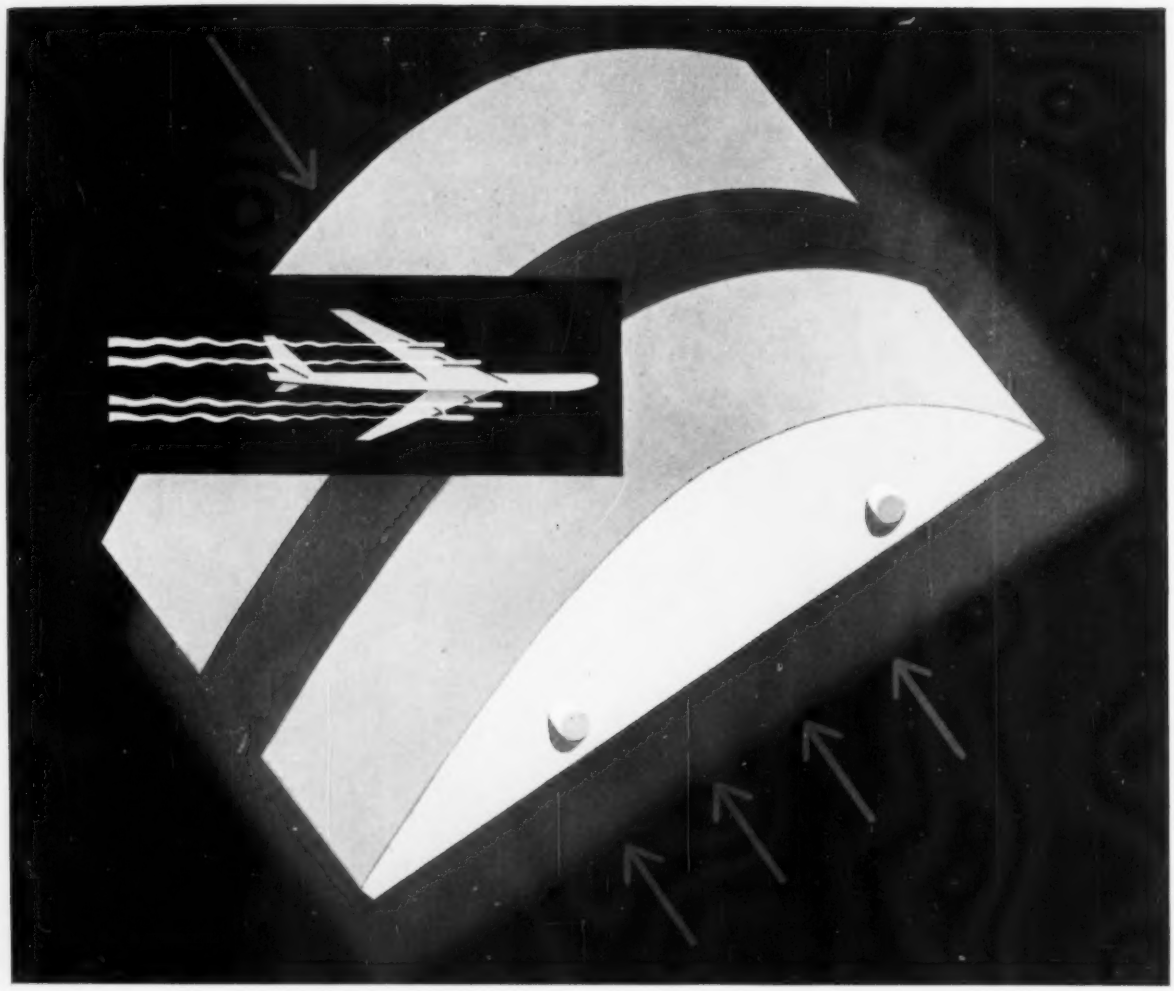
PLASTICS

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

FEBRUARY 1959

Facts on 1959 compression and transfer molding presses



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Your tooling resin formulator will show you how Epon resin formulations save time and money in applications such as these:

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Catalin POLYETHYLENE

blossoms into beauty *in flowers by* beco

The ruggedness that qualifies CATALIN POLYETHYLENE as the material for molding hard-usage items like toys and housewares is, strangely enough, the reason for its choice to capture the delicate beauty of natural blooms in Beco* flowers.

These durable, inexpensive garden-mimics — washable even in hot water — are assembled from injection-molded petals and leaves and from extruded stems, to produce lifelike roses, tulips, carnations, chrysanthemums . . . even lacy ferns! Mounted as a bouquet in a handsome flower-holder of injection-molded Catalin High Impact Styrene and attractively packaged in Polyethylene film, the blossoms are kept enticingly immaculate for display in the household they will brighten.

CATALIN POLYETHYLENE — whose versatility is thus pleasantly exemplified — is available to you for the manufacture of many other types of product — hardware, appliances, chemical and hospital ware, bottles, packages, pipe, film or sheeting —in the widest range of densities and melt indexes. From these you can select the formulation that is exactly right for your purposes. Inquiries invited.

**Beco flowers and flower-holder are manufactured by Bernard Edward Co., 5252 So. Kolmar Ave., Chicago 32, Ill.*

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ONE PARK AVENUE • NEW YORK 16, N. Y.

Catalin

Catalin plastics include polystyrene, polyethylene and nylon molding and extrusion compounds.

Catalin produces a wide range of urea, phenolic, cresylic, resorcinol and melamine resin formulations.

Catalin chemical intermediates and specialties include antioxidants, bacteriostats and alkalation products.

PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

FEBRUARY 1959 VOLUME V NUMBER 2

FEATURE ARTICLES:

ENVIRONMENTAL STRESS-CRACKING RESISTANCE OF HIGH-DENSITY POLYETHYLENE p.35
By F. H. McTigue

High molecular-weight resins, proper molding, and incorporation of elastomers into the plastic formulation are shown to provide increased resistance to environmental stress-cracking when applications are exposed to certain media. The second factor, through proper mold design and choice of optimum temperatures and molding cycles, plays an important part in injection molding.

MAKING TRAILER BATHTUBS OF REINFORCED POLYESTER WITH URETHANE FOAM BASES p.40
By D. M. Ware

Vibration-free bathtubs, suitable for use in trailers and permanent homes, offer lower manufacturing costs than conventional tubs, are installed easily, are light in weight, chip-proof, resistant to household solvents and cleaners, and easy to maintain.

RESIN CHARACTERISTICS RELATING TO LAMINATE BEHAVIOR p.44
By F. N. McGarry

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PUBLISHED MONTHLY BY

Plastics Technology Publishing Corp., a Division of

NBP BPA

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BILL BROTHERS PUBLISHING CORPORATION
630 THIRD AVENUE, NEW YORK 17, N. Y.

Photo courtesy The Akron Preform Mold Company, Cuyahoga Falls, Ohio

New route to really good roto-castings

The most important requirement of a really good vinyl compound for roto-casting is good plastisol flow. This, in turn, is a function of plastisol viscosity and gellation rate and temperature.

The route to just the right combination of plastisol flow and fusion has been greatly simplified by the recent development of a series of formulations based on blends of certain PLIOVIC resins. These resins are PLIOVIC AO, PLIOVIC VO and PLIOVIC S50.

The net result of combining any two of these high-quality, tailor-made PLIOVIC resins is unusually close control of plastisol flow and fusion over a complete range of hardness. What's more, these PLIOVIC blends require smaller concentrations of plasticizer to provide significant production economies and higher physical properties in the end product.

For full details on the advantages of PLIOVIC blends for really good roto-castings, including the latest *Tech Book Bulletins*, just write Goodyear, Chemical Division, Dept. B-9441, Akron 16, Ohio.

GOODYEAR

CHEMICAL DIVISION

Pliovic–T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

Letters to the Editor

Previews of Next Month

The March issue will feature the following articles:

Low-Density Cellular Vinyl by Post-Expansion Methods. Donald Esarove and R. J. Meyer, both Development Engrs., B. F. Goodrich Chemical Co., Avon Lake, O.

Materials (including resin, blowing agent, stabilizer and lubricant) and equipment are discussed in detail. Core materials, expansion ovens, supporting materials, and cooling and take-up equipment are described, as are properties and applications for the 1-d cellular products.

•

Coatings for Vacuum Metallizing on Plastics. M. A. Self, Pres., & John Scharnberg, Res. & Devel. Engr., Logo Div., Bee Chemical Co., Chicago, Ill.

Application methods and formulations for the top and base coatings are detailed, with emphasis on base coat problems, general film problems and properties, coating methods, and the future outlook.

•

Comparison of Phenolic and Polyester Premix Materials. J. J. Calao, Chemist, and M. M. Gurvitch, Chem. Engr., Plastics & Coal Chemicals Div., Allied Chemical Corp., Edgewater, N. J.

Data are given to show that the two materials have many overlapping properties, but also possess some unique abilities. Intelligent judgment must be exercised in selecting the best suited material for a given application in order to obtain the most satisfactory performance.

•

Optical Properties of Translucent, Glass-Reinforced Panels. Daniel Smith, Dir. of Physics Res., & J. B. Crenshaw, Devel. Engr., both of Finishes Div., Interchemical Corp., New York, N. Y.

In an investigation of optical properties of translucent panels made with unsaturated polyester resin containing acrylic monomers, the characteristic of scattered light (haze) was found to be most prominent. The color, amount of color, and color purity of the scattered light were found to be functions of the reinforcement components.

•

To Err Is Human

Dear Sir:

On page 1129 of your December issue is a brief article, entitled "PVC Protective Funnel." May I call your attention, please, to the external house organ of our client, the American Agile Corp.

Evidently your staff obtained the wrong information, since this funnel is of polyethylene and not PVC. I am not suggesting a re-run or retraction, but merely set the record straight for your own information.

H. F. Eaton
Dix & Eaton, Inc.
Cleveland, O.

(We would like to set everyone straight that the funnel is polyethylene. In our defense, the original release which we received from Pfaudler's Public Relations representative stated that the material was PVC.—Editor)

• • •

Additives for Polyester Panels

Dear Sir:

Do you have information on additives that can be used in polyester panels that will cut down solar radiation and heat transmission?

A. S. Suleiman, Vice-Pres.
Valco, Inc.
St. Petersburg, Florida

(In replying to this inquiry, Lee Zukor, our Engineering Editor, mentioned two additives; a pearlescent pigment for use either before or after fabricating the panels, and an opaque pigment containing carbon black. Both have good reflectivity and fair heat absorption qualities. The first type of pigment allows for light transmission, too. Quantitative tests are presently being conducted on the pearlescent pigment on similar applications.—Editor)

Information Wanted

Dear Sir:

In behalf of the Gama Toy Co. of Fuerth, Germany, I am writing to ask for information about polyethylene and other plastic materials for use in the manufacture of toys.

At present, Gama Toy Co. manufactures only metal toys and would like to convert some into plastic toys. They have the presses and can make their own molds. The problem is to be supplied with the plastic materials and to understand the methods of handling them.

They would greatly appreciate all the information, samples, etc., you can send, also information regarding qualities and quantities. Please send these things to Eugene Strecker, Gama Toy Co., 71 Langestrasse, Fuerth, I. B., Germany.

Mrs. E. G. Strecker
Chicago 45, Ill.

•

Handles for Cutlery

Dear Sir:

We are desirous of locating manufacturers of all types of handles for steak knives and carving sets which can be used in the manufacture of our cutlery.

We wonder if you could put us in touch with any firm already manufacturing various types of handles.

B. Abbott, Pres.
Abbott of England, Ltd.
Toronto, Ont., Canada

(We print this letter only to remind our readers that we are prepared to answer different types of inquiries, technical and non-technical. Anyone desiring to propose his firm as a supplier of cutlery handles can write either directly to the inquirer or to this office for transmittal to Mr. Abbott.—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

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Industry usage* endorses

hr PLENCO HEAT RESISTING PHENOLIC COMPOUND 349

FOR APPLIANCE handles, knobs and trim that must have the highest possible heat resistance, molders recommend and leading manufacturers specify Plenco 349 HR. because:

- It possesses a heat resistant range up to 500°F.
- Offers superior surface finish, smoothness and lustre that adds to the beauty and saleability of the appliance.
- Provides efficient production due to the fast cure and excellent mold release characteristics of the material.
- Assures dependability: To the molder because of its uniformity—to the end user because of its molded characteristics.

*We estimate that (since its introduction in 1952) eighty to one-hundred million parts have been molded from Plenco 349 HR. . . . and for many of the best-known names in the appliance industry.

Investigate the good reputation of this excellent material; it will serve you well.

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

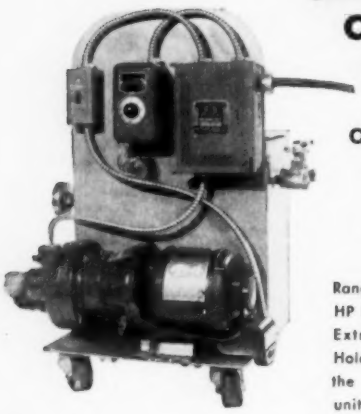
IF PHENOLICS CAN DO IT—
plenco
CAN PROVIDE IT...
already-made or specially-made

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

IMS LOW COST INJECTION MOLD TEMPERATURE CONTROL UNITS
— STOCK MODELS —

IMS LOW COST
INJECTION MOLD TEMPERATURE CONTROL



Quick Positive HEAT

Only 15" x 22½" Floor Space

Lowest Maintenance

Features

Range 50-250°. 20 GPM, ¼ HP Pump. 4500 Watt Heater. Extra heavy duty relay. Holds heat ± 2°. Performs the same job as big costly units. Closed circuit. Trouble-free.

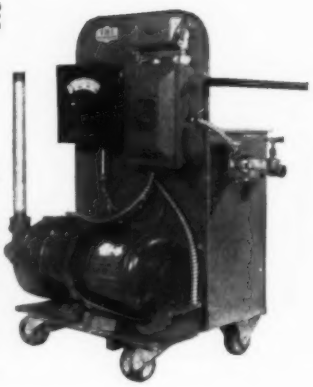
Low Cost Model

Price Complete **$369.50**

220 volt; 60 cycle; 1 phase

IMS AUTOMATIC
INJECTION MOLD TEMPERATURE CONTROLLER

HEATS AND COOLS WITHIN ± 1 DEGREE



Features

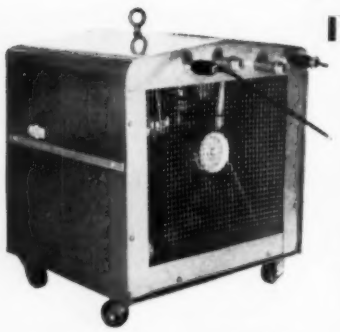
Single Automatic Control for both heating and cooling. Heavy duty relay. ¼ HP Pump. Cooling coils permit closed circuit recirculation of heat transfer medium, and require water and drain connections for full automatic operation.

Automatic Model

Price Complete **$585.00**

220 volt; 60 cycle; 1 phase

IMS SCOTSMAN
closed circuit



INJECTION MOLD COOLER SAVES WATER

Use with any circulator to cut your water bills!

Features

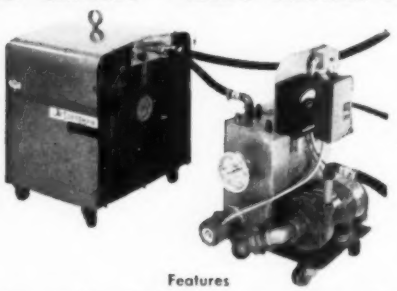
Special fan-cooled radiator. Plug in solenoids attach Scotsman to any mold circulator. Complete information in Operating Instructions on request. Automatically re-uses circulator cooling water. Requires 110 volt fan and 220 volt solenoid connection.

IMS SCOTSMAN MOLD COOLER

Price Complete **$396.50**

For use with all makes of mold circulators

IMS COMBINATION HEATER COOLER
FOR INJECTION MOLDS
CLOSED CIRCUIT — ENDS WATER WASTE



Features

Reversible two speed fan. Single sensitive control—one setting regulates both heating and cooling. Holds mold heats to within ± 1 degree F. Range on most molds: 212° down to 10° above ambient air temperature. Closed circuit. Requires 110 volt fan connection and 220 volt 60 cycle 1 phase line for Automatic Circulator.

IMS Combination Automatic Mold Temperature Controller and Air-Cooled Scotsman Water Saver.

Price Complete **$922.50**

Send for Our Plant Equipment, Nozzle and Heating Cylinder Catalogs Today!

INJECTION MOLDERS SUPPLY CO.
3514 LEE ROAD • WYoming 1-1424 • CLEVELAND 20, OHIO

AIR GUIDE CEILING DIFFUSER

FIRST IN THE FIELD

flame-retardant ...corrosion-proof

at a fraction of the cost of metal!

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HIGH DENSITY POLYETHYLENE

One plastic . . . and only one . . . could do this demanding job, replacing metal at a fraction of the cost. For only one plastic . . . GREX high density polyethylene . . . gave the molder *all* his performance requirements . . . *in a flame-retardant compound.*

Designed by AirGUIDE Plastics Corporation for air conditioning and heating systems, this diffuser is guaranteed distortion-free and corrosion-proof. It is molded in a single piece, lightweight yet rugged. And the colors are permanent, won't flake or peel as painted metal often does.

Flame-retardant GREX, natural or in color, has dozens of brand-new, profit-making applications, many of them as replacements for metal and other materials. It can lead you into markets still untapped by any plastic. Write for full details, *today.*

W.R. GRACE & CO.

POLYMER CHEMICALS DIVISION

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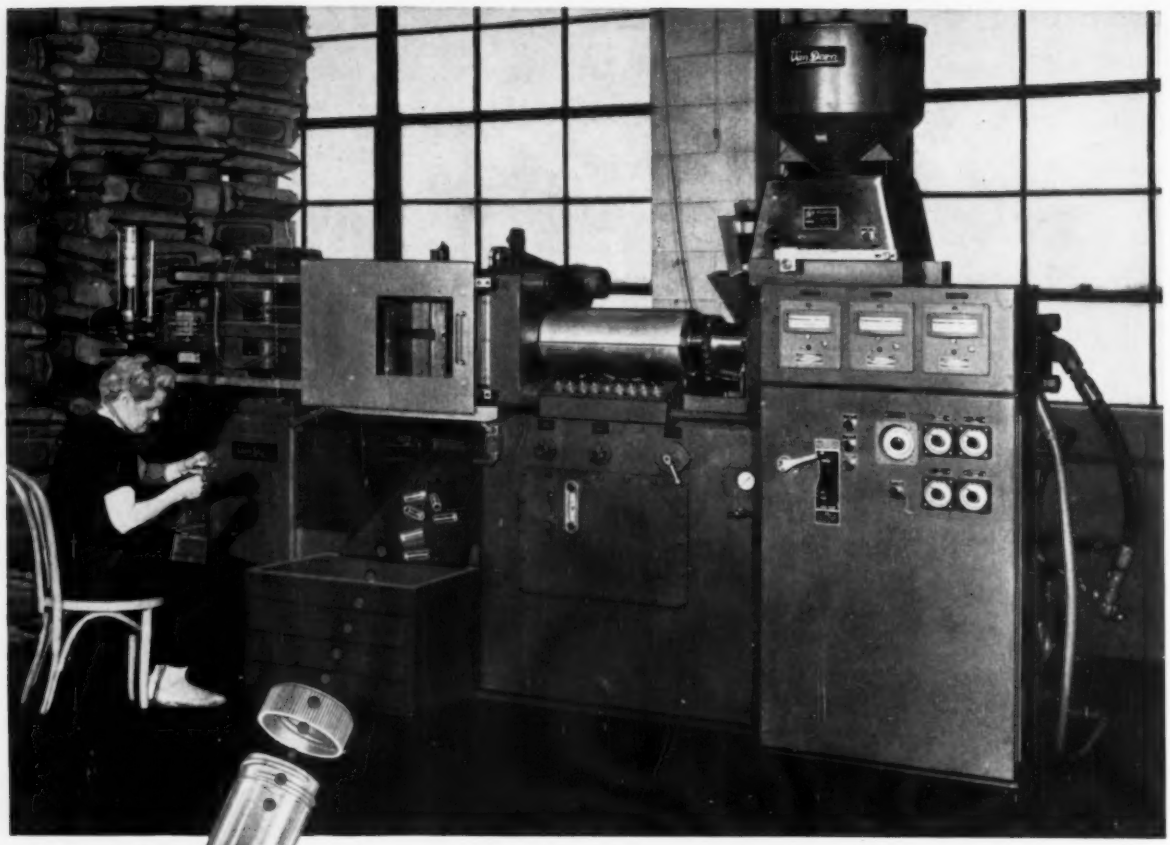


Styrene containers produced on H-400 press. Polyethylene closure produced on the versatile Van Dorn H-260.

Proved Performance

in the field by

VAN DORN model H-400 4 oz. press

Van Dorn Model H-400 press owners are reporting excellent results in their operations. For example, De Mar Products, Inc., 1317 Chesapeake Avenue, Columbus 12, Ohio, produces the styrene medical specimen containers illustrated with a *hot runner mold.* De Mar management says the Van Dorn press provides fast, dependable, fully automatic production.

This operation is a typical example of Van Dorn's unique "Package Service" for customers.

De Mar had a well conceived idea for a plastic part, but no experience in molding. They came to Van Dorn, whose engineers helped them procure a well-designed mold from a competent mold maker, and then checked the operation of the finished mold in the Van Dorn factory at no charge.

Such Van Dorn "Package Service" insures satisfaction, helps produce profits. *It is available to you also.*

Write for folder on Model H-400 Press

THE Van Dorn IRON WORKS CO.

2685 EAST 79th STREET · CLEVELAND 4, OHIO

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

FEBRUARY, 1959 U.S. INDUSTRIAL CHEMICALS CO., DIVISION OF NATIONAL DISTILLERS AND CHEMICAL CORPORATION, 99 PARK AVE., N. Y. 16, N. Y.

Packaging Notes

New rim seal packaging machine that effects considerable savings in time and packaging film is being placed on the market. The hand-operated machine was designed for use in small food packaging operations, such as are common in super markets. The machine seals polyethylene film to the rim or lip of the food tray or container in a single operation. By eliminating the extra film that normally is folded and sealed under the tray, the machine reportedly saves almost 60% of the amount of film needed to make a sealed package. It is claimed that the machine can produce three to four times as many packages in a day as can be made by present hand wrapping methods.

The machine employs an electrically heated and thermostatically controlled upper section which is brought down on the film to make the rim seal. The heat sealing surfaces can be changed quickly for almost any size or shape of container. A set of sealing shoes for conventional package sizes and shapes is included with the machine.

Pressure-sensitive, paper-backed polyethylene tape solves problems of joining and patching poly film used in agriculture and as a water vapor and dust barrier in the construction field. The tape is easily applied by removing the paper backing and firmly pressing the tape smooth. The tape meets general building requirements, including FHA specifications.

Grain and silage can be packaged and preserved in poly bags, according to a study made at a leading Midwest agricultural school. Previous attempts to accomplish this with conventional bags failed because the bags permitted air to enter the package, spoiling the high moisture silage. Polyethylene reportedly lets gas escape, but prevents air from entering.

A new process permits polyethylene coated bags and cartons to be run on standard glue-sealing machinery at high speeds, using low-cost dextrin and starch adhesives. The process is expected to increase sharply the use of polyethylene-coated materials for packaging.

Possible applications include boxes for chlorinated powdered detergents, cereals, cake mixes and other products requiring sift-proof containers. Need for a loose inner liner would be eliminated. Polyethylene-coated cartonboard for frozen food packages would also cut costs by eliminating the need for overwraps.

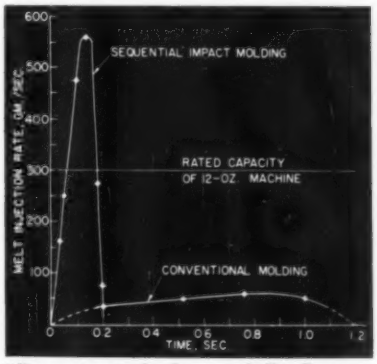
First commercial use for the process is in packaging personal hygiene products in a box made of polyethylene-coated paperboard. The coating replaces a glassine-paper laminate.

Sequential Impact Molding: New Technique Increases Output, Simplifies Fill Control

Method Based on Precisely Timed Release of Precompressed Melt

A radical improvement in the still new technique of impact molding was announced recently. Called Sequential Impact Molding (SIM), the new method reportedly yields from 30 to 50% more pounds of finished pieces per hour than the best yields for the same equipment employing conventional procedures. Mold filling rate is said to be increased six-fold.

In ordinary impact molding, the melt is precompressed, then "exploded" into all the mold cavities at one time. With SIM, the cavities are filled in carefully timed sequence, with each cavity receiving the full pressure of the injection setup. Sequencing is achieved by timed opening and closing of the valves in a multiple-nozzle manifold. The advantage of this method over sequenced valve gating is that all the special equipment is in the injection end of the machine rather than in the mold. One valving setup may be used for many different molds.



Filling rate graphs for two half-gallon containers molded under identical conditions by sequential impact molding and by conventional means.

Faster Filling Speed

In addition to increased output, one of the biggest advantages of SIM is reported to be the speed with which the cavities are filled. With SIM, cavity filling is so fast that mold temperature is no longer critical and amount of flow into the mold is more easily controlled. This speed also eliminates core shifting and weld lines by reducing the usual large, around-the-cavity pressure gradients that are responsible for core shifting in bottom gated cavities. SIM is also said to eliminate warping of thin sections caused by locked-in stresses.

Sequential opening of the valves also reduces clamp requirements, since only one cavity or group of cavities is filled at any one time. Thus, clamping force needed is much less than if all the cavities were filling together. This permits an increase in the number of cavities without undue concern for clamping capacity.

Equipment for SIM is being made and sold under license from the company which developed the technique. Both new molding machines and conversion kits for adapting existing equipment are being offered.

Booklet Describes Chemical Growth of National Distillers

A full color brochure describes the growing contribution to the chemical industry of National Distillers and Chemical Corporation. The 36-page booklet takes readers on a photo tour of plants operated by U.S.I. and its affiliated companies. Products of these operations — polyethylene, petrochemicals, agricultural and industrial chemicals, corrosion-resistant metals and high energy fuels — are described.

The brochure may be obtained by writing Editor, U.S.I. Polyethylene News, U.S. Industrial Chemicals Co., 99 Park Avenue, New York 16, N. Y.

To Wrap 1500-Mile Pipeline With Polyethylene Tape

Work has begun on a $3 million contract to wrap an entire 1500-mile pipeline with polyethylene tape. Although poly tape has been used extensively as a protective wrapping for pipelines, this reportedly is the first time that a major system has been completely wrapped with tape.

The pipeline runs from Baton Rouge, La., to Cutler, Fla. and is made of pipe varying from 18 to 24 inches in diameter. The contract represents the largest single order ever placed for a protective pipe coating of any kind.

Poly Wraps Win 32 Awards In Packaging Competition

Polyethylene bags and wraps took a total of 32 prizes recently in the third annual Flexible Packaging Competition, sponsored jointly by the National Flexible Packaging Association and Paper, Film & Foil magazine. Poly packages won more awards than were given to all other packaging materials combined. The top award of the competition went to a polyethylene package for girdles.

U.S.I.

Vol. IV, No. 1

POLYETHYLENE PROCESSING TIPS

PRINTING ON POLYETHYLENE FILM: HOW TO GET BEST RESULTS IN FLEXOGRAPHIC PRINTING

In the last edition of "TIPS" (Vol. III, No. 6) a review was made of the methods for pretreating polyethylene film surfaces so that commercially available printing inks will adhere well. Since most commercial printing on polyethylene film today involves the use of flexographic techniques, this method of printing film after it has been surface-treated has therefore been chosen as a topic for discussion. Film processors who have just acquired flexographic printing equipment and those who plan to add such equipment should find this of particular interest.

Performance of Flexographic Inks

Because polyethylene is nonabsorbent toward inks, even after surface-treating, the commercial flexographic inks developed for printing on this material are of the nonabsorbing type. They are relatively fast-drying, and usually possess high gloss. They do not require high temperatures for drying.

In general these inks are composed of a solvent vehicle, a resin binder and pigment plus various additives to impart gloss, etc. The drying speed of an ink, important in rapid multicolor printing, depends on the solvent vehicle. Combination solvents are generally used for flexographic inks so that drying speed can be varied readily by changing the solvent mixture ratio. Where hydrocarbon-type solvents such as naphtha are used, *synthetic rubber* plates and rollers must be employed to prevent swelling and deterioration.

While the resin binder in the ink acts as the adhesive agent, the gloss and antiblock additives play an important role. Formulations must be checked constantly by the ink manufacturer for proper adhesive properties.

Some Printing Hints

Processors should keep in mind that solvents used for different types of inks – such as hydrocarbon inks and alcohol inks–are usually not miscible and should not be mixed.

Most flexographic inks require constant mixing by recirculation or other methods to maintain color uniformity.

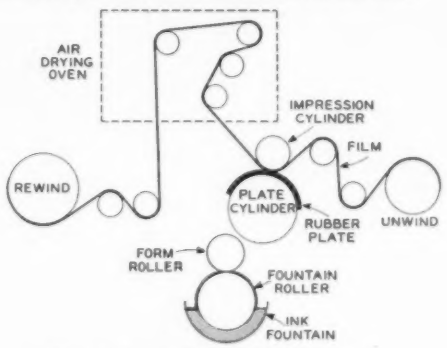
The first ink down in a multicolor printing operation must be the fastest drying and each successive color can be slower. Also, in a multicolor operation, it is desirable to print lighter colors first, followed by darker inks. This prevents noticeable color contamination that would otherwise occur.

Here is an important fact to remember in printing on extremely thin gauge film. Such film is usually surface-treated very lightly, thereby increasing the possibility of poor ink adhesion. In this case it is often possible to place a base ink on the film surface over the same areas to be printed later. This base ink may possess high adhesion but poor gloss and antiblock. However, overprinting with other inks will remedy these poor qualities. The adhesion of ink-to-ink is much greater than ink-to-polyethylene, and so overprinting with glossy inks will result in both desirable adhesive and appearance properties.

Tests for Satisfactory Printing

If the processor does not extrude, surface-treat and print all in line, it may sometimes be necessary to test unprinted film to see if it has already been treated. Visual inspection will not give the answer. However, ability of the film to be wetted by water is increased after treatment, so that a determination of wetting characteristics will reveal the extent of treat.

The Scotch Tape test, described in U.S.I. Polyethylene Processing Tips, Vol. III, No. 6, as a control in the surface-treating operation, is also used to determine how well the ink is adhering to the printed film as it comes off the press. Here the tape is applied to the printed film after drying. It is then drawn back slowly over about half its length and rapidly pulled off the remaining area. Printing is satisfactory if no ink is removed from the film.



Schematic diagram of flexographic printing process.

U.S.I. Will Advise

This has been only a brief summary of some of the more important phases of flexographic printing on polyethylene film. As a manufacturer of polyethylene resins, U.S.I. has studied the subject in some detail and is equipped to help the processor with his printing problems.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
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A long, trouble-free life is the forecast for electrical parts protected with RCI EPOTUF epoxy resins. Insulation made with these resins and appropriate hardeners is tough enough to surpass the most rigorous electrical and mechanical demands. Room temperature curing means no heat of reaction to harm delicate components.

Elements encapsulated, embedded or potted in EPOTUF epoxy resins are virtually free of failure, thus minimizing the need for costly maintenance and increasing the overall efficiency and reliability of the complete unit.

EPOTUF resins harden with outstanding adhesion to metals, glass, ceramics and other materials. They offer high mechanical strength and superior dielectric properties. The liquid nature of these resins permits penetration of fine crevices, and their low shrinkage assures highest dimensional stability.

If these numerous advantages of durable, dependable, corrosion-resistant EPOTUF epoxy resins fit your application, get in touch with RCI.

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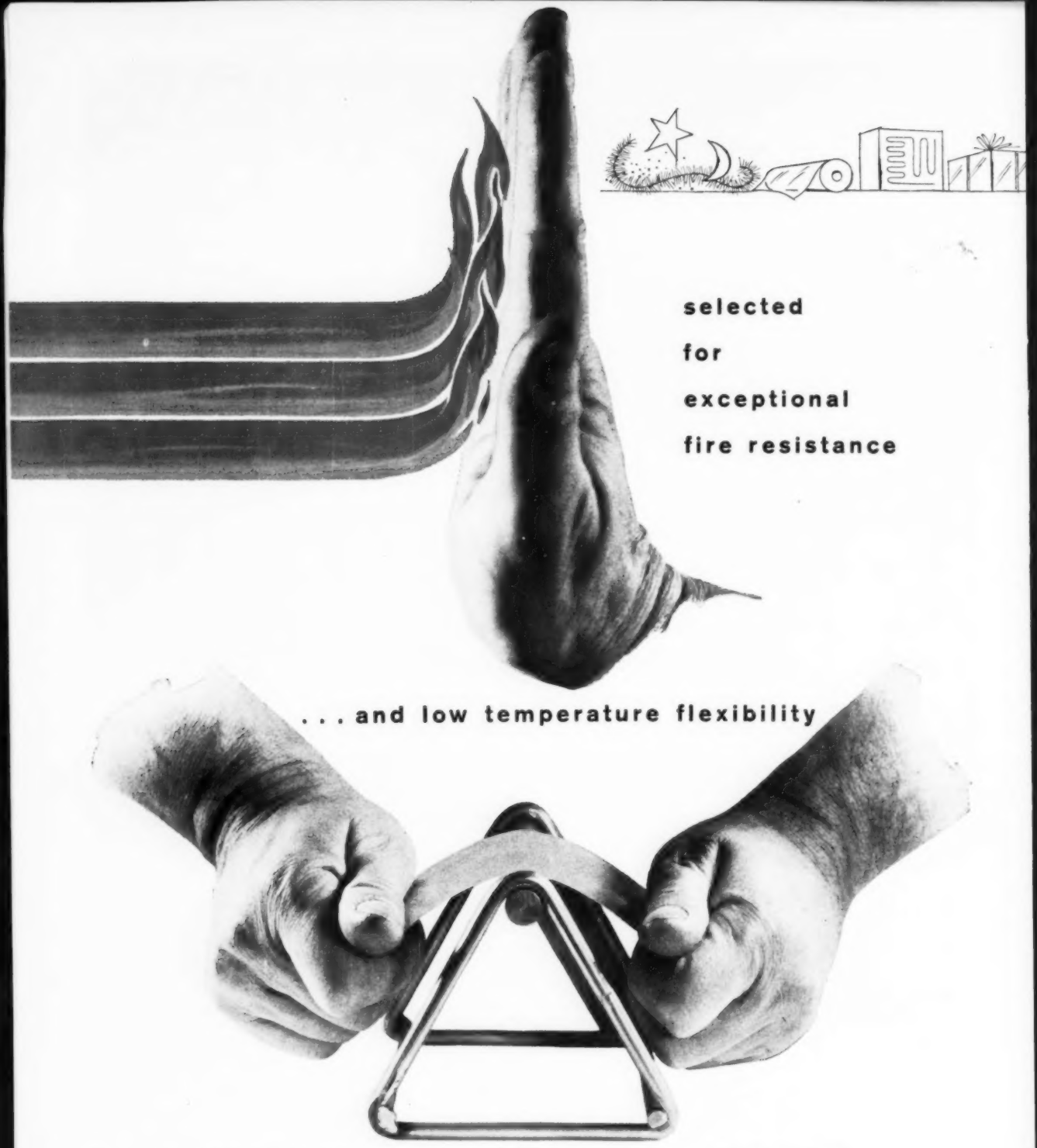

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Celanese is an expanding source for plasticizers for many jobs. Shipments from convenient distribution points are ready to meet tight schedules. Write Celanese Corporation of America, Chemical Division, 180 Madison Avenue, New York 16, for complete information. Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.

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PLASTICS TECHNOLOGY

FEBRUARY, 1959

EDITORIAL: Compression and Transfer Molding Machines

This issue marks another milestone in our publication history—the third installment of our special feature series covering the major classes of plastics processing machines. In this issue, we deal with compression and transfer molding machines (presses) available from domestic machinery manufacturers. The preceding installments covered injection and extrusion machines, and appeared in our May and September 1958 issues, respectively.

Following the system established in the preceding installments, this issue's feature section consists of two parts: a special introductory article written by Frank Donohue, Monsanto's expert on compression and transfer molding machines; and a staff-written comparative tabulation of specification data for the subject presses.

Since many compression and transfer molding machines are literally built to meet the individual requirements of the customers, the tabulation is followed by a listing of manufacturers whose presses are custom-built to order, with few or no standard models.

●

As indicated in the preceding installments, our pride in this special section is tempered by the realization that it represents only a major step forward towards the goal of machinery standardization and proper understanding by the processor/customers that is so badly needed by the plastics industry before it can achieve true maturity.

Accordingly, we know that this special section will join its predecessor sections in popularity and wide acclaim. But even more important, however, all three sections show the current status of machine standardization and point up the need for further progress towards this end that will benefit both the machine manufacturers and their customers (and through them, the entire plastics industry).

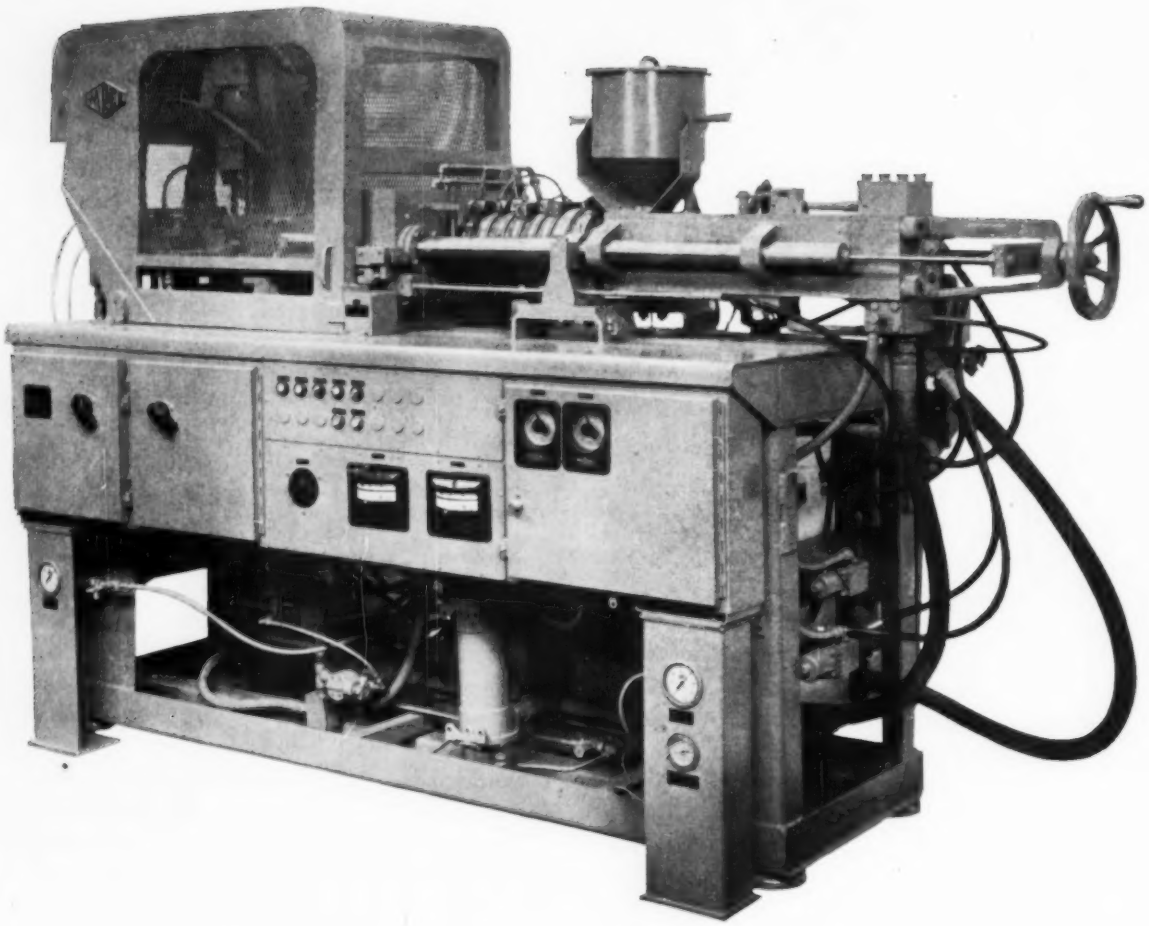
To re-emphasize this point, we are planning to repeat this three-pronged cycle and will have the next injection machine special feature in May; the next extrusion machine special in September; and the next compression and transfer machines special feature in February 1960.

●

As in the past, we earnestly invite comments on the special feature sections from both the machine manufacturers and our plastics processing readers. Your suggestions and comments will receive serious study and consideration so that our next section on each type of machine can be better, more useful, and more valuable to everyone concerned.

We want to repeat, however, that your letters will not be published in our "Letters to the Editor" department if such publication is not desired. But please write or phone us!

Arthur M. Merrill
Editor



ANOTHER NEW IMPCO

Special Purpose Injection Molding Machine for Containerlike Molding

MODEL CA30-75

- 30-50 gram capacity
- 30 molding cycles per minute*
- shut-off nozzle for pre-pressurized molding
- simplified mold construction
- built-in die and platen cooling arrangement
- separate injection and clamp hydraulic circuits
- shock mounted control panel
- photo electric recycling monitor
- 75 ton clamp
- 9¼" stroke
- fully automatic

*dependent on material and mold construction

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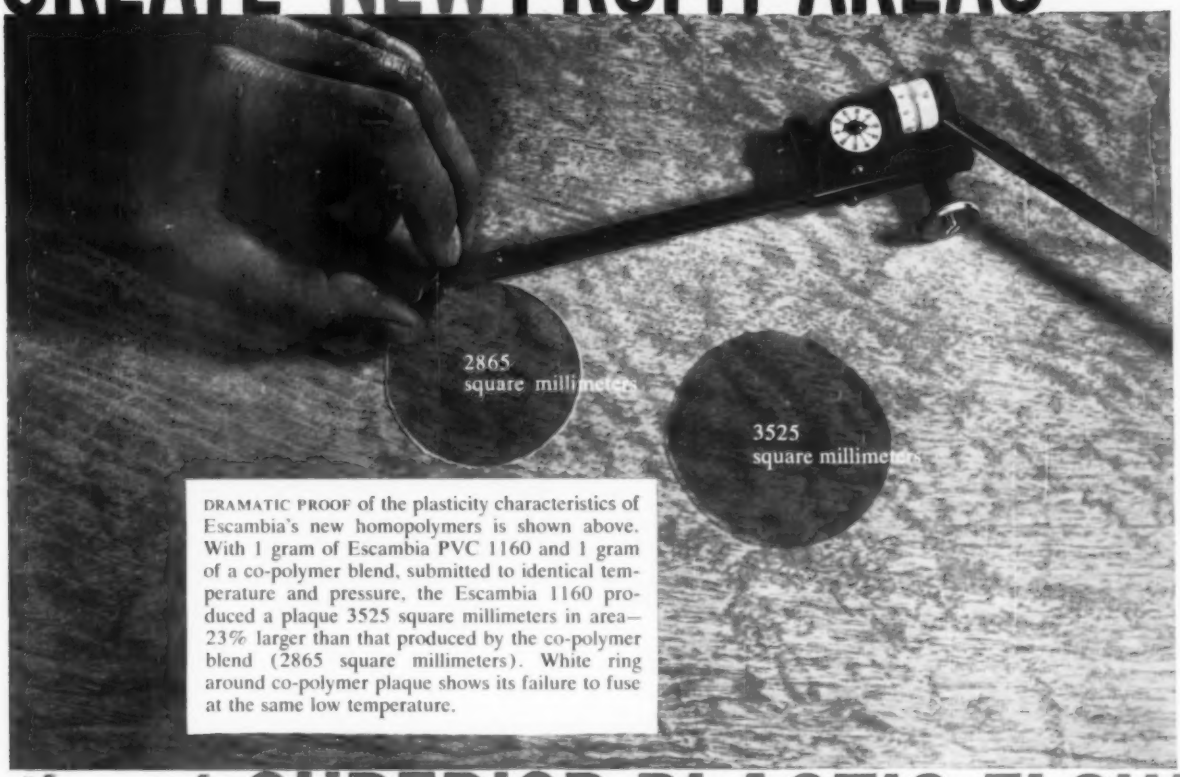

DRAMATIC PROOF of the plasticity characteristics of Escambia's new homopolymers is shown above. With 1 gram of Escambia PVC 1160 and 1 gram of a co-polymer blend, submitted to identical temperature and pressure, the Escambia 1160 produced a plaque 3525 square millimeters in area—23% larger than that produced by the co-polymer blend (2865 square millimeters). White ring around co-polymer plaque shows its failure to fuse at the same low temperature.

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In many operations where conventional co-polymers are now used, ESCAMBIA PVC 1160 and ESCAMBIA PVC PEARLS 2160—two new low molecular weight homopolymer resins—offer these performance and processing advantages.

Take advantage of these properties in your production and processing now. Write Department T2 at the address below:

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Polyester resins made with **Oronite Isophthalic** *perform better!*

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NEWS in BRIEF

Plastics and plastics engineering should be popularized among young people, says A. G. Winfield of DeBell & Richardson, Inc. (see Guest Editorial, pgs. 43, 52). He suggests a program for interesting and informing young people both before and at the secondary-school level that would instill in them a desire to become part of the plastics industry.

Business developments in the plastics industry started the year in fine fettle. Ace Plastics plans to enter the heavy industrial and extrusion field. American Can consolidated two subsidiaries into a Bradley-Sun division. An expansion of its sales organization was announced by Chemo Products. Cinmastra Division of Cincinnati Milling Machine Co. was formed for the custom molding of reinforced plastics. Columbian Carbon set up a West Coast representative. Dow invested $2.3-million in Catalin Corp. of America. Eastman Chemical Products set up two new groups to speed flow from its labs to industry. Formica is setting up a field manufacturing organization. Glidden will channel all West Coast sales activities through its own offices. Hastings Plastics now carries the Borden line of epoxide resins on the West Coast. Hooker has been given a patent for its vented mold. Puratize has developed a process for rendering plastics materials bacteriostatic, and will license it to molders and makers of molding compounds. Shell Chemical formed four new, fully-integrated divisions. A. O. Smith set up a reinforced plastics division. Waljohn Plastics will distribute its luggage, case covering and Tourex extrusions directly to customers.

Company expansions in plastics continue in the news. Bel-Art Products opened its new plant in Pequannock, N. J. DuPont will be producing linear polyethylene at its Sabine River Works in Orange, Tex., by mid-1950. The company's Film Department plans to increase its production capacity for Mylar polyester film by 30%, building new facilities near Circleville, O. M. C. Gill is installing new facilities at South El Monte, Calif., to enter the field of honeycomb constructions. Jefferson Chemical opened an ethylene plant at Port Neches, Tex. Monsanto increased its production of phthalate ester plasticizers at Texas City, Tex. Reichhold equipped its new Ballardville, Mass., plant for the production of 10-million pounds of acrylic emulsions annually. The company also has begun construction of a chemicals plant in Elizabeth, N. J. Structoglas Div., International Molded Plastics, completed a new plant in Grand Junction, Tenn. Reynolds Chemical will build new facilities for plastisol coatings and urethane foams at Ann Arbor and Ypsilanti, Mich. Tri-Point Plastics expanded its production of precision-machined plastics parts by 30%. Tube-Kote is constructing a pipe coating plant near Midland, Tex. Ultra Plastics has leased new space in Philadelphia, Pa.

New Materials that merit attention (see pages 85-8): water-wash detergent and degreasing solvent; single-component epoxy adhesive; self extinguishing, paper-base phenolic laminate; catalyst for urethane foam; ultra violet light absorber for most polymeric materials; heat-reactive phenolic resin; polymeric plasticizer; high melt-viscosity, high molecular-weight nylon; heat and light stabilizer for vinyls; synthetic pearling agent for resins; phthalocyanine blue pigment; and liquid epoxy casting resin.

New Equipment of special interest (see pages 89-91): dual drum tumbler for dry coloring; pyrometer-type temperature controller; accelerated aging test unit; carbide-tipped trimming tools for plastics; expansion joint of rigid PVC; automatic flash trimmer and contour forming machine; and a plastics grinder for beside-the-press use.

Plastics Applications to be noted (see pages 93-5): indoor-outdoor chair with foamed vinyl cushions; impact-resistant polyethylene boxes; planetary, gear-driven counter with molded nylon components; molded polymethylstyrene pitcher for measuring; glass-polyester boat with built-in flotation compartments; power mower with high-density polyethylene parts; molded urea parts in photoprint copier; floor covering with vinyl tread surface; metal ice bucket with high-density polyethylene liner; custom-made prelaminated materials; custom-extruded PVC door channels; and molded styrene aquarium.

Greater latitude in radio cabinet design is permitted by the higher heat resistance of CYMAC® 400 polymethylstyrene plastic which will withstand continuous service at temperatures to 212°F without distortion. This property, plus its ready adaptability to complex molding and its excellent flow and color characteristics, was one of the reasons it was selected for the cabinet of the RCA Victor table radio, *The Burgess*, illustrated here.

Additional advantage of CYMAC is that it has sufficient flexibility for back cover to be secured without fasteners: a simple snap-fit reduces cost, speeds assembly, and facilitates disassembly if required. The following properties indicate CYMAC 400 is an ideal material for radio cabinets and similar housing requirements:

Resistance to heat, °F (cont.)	212
Heat distortion temperature, °F	213
Molding shrinkage, in./in.	.0046
Specific gravity	1.02
Flexural strength (1 in./min crosshead speed)	12,500
Impact strength ft/lb/in. of notch (½ x ½ in. notched bar, Izod Test)	.30
Rockwell hardness	76M
Dielectric strength, short time, ⅛ in. thick volts/mil, 1/16 in. disc	890

CYANAMID

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New ideas in product design and application of Cyanamid plastics.

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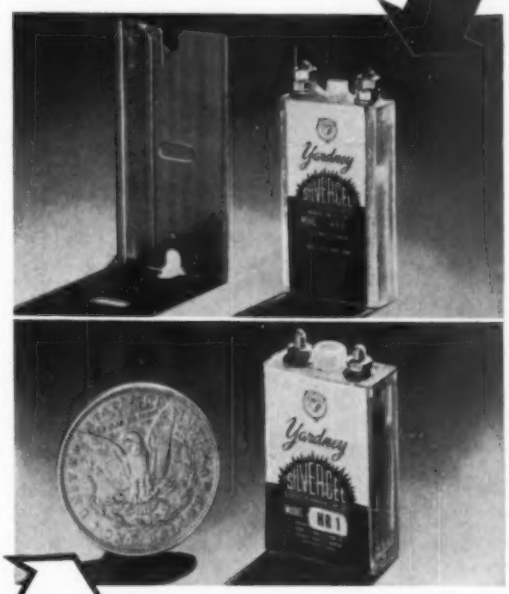
World's smallest and lightest rechargeable battery cell, shown here with razor blade, is Yardney Electric Corporation's HRO1 Silvercel®. Designed primarily for use in instrumentation and telemetering packages for missiles and rockets, it has a 3 amp peak pulse discharge and weighs less than one-seventh ounce – thanks in great part to lightweight molded CYMAC SUPER* 201 thermoplastic case and cover.

*Trade mark



Another Yardney silver-zinc cell is shown here with a silver dollar for size comparison. This HR1 Silvercel® delivers a 45 amp peak pulse discharge yet weighs only ¾ ounce. CYMAC SUPER 201 methylstyrene-acrylonitrile copolymer was selected because of its:

- Low specific gravity (1.06)
- Exceptional combination of high tensile (11,000 psi) and high flexural (16,100 psi) strengths
- Heat resistance (distortion point 211°F)
- Complete resistance to concentrated potassium hydroxide electrolyte
- Excellent injection molding characteristics, transparence, resistance to crazing, and ease of solvent-sealing covers to cases.

New cordless electric shaver features light weight (two ounces), damage-resistant case of CYMEL® melamine plastic, designed by Raymond Loewy Associates. This smart-looking Universal shaver operates anywhere on ordinary penlight or transistor batteries. The CYMEL case is contoured to fit the hand, corrugated at the top for a natural, easy grip.

Battery and motor unit are secured by light press fit in housing compression-molded of CYMEL 1079 melamine molding compound. CYMEL resists breaking, chipping, scratching, perspiration, and corrosion from shaving lotions and battery chemicals. It provides a rich look and warm feel. Color, molded in, can't chip or wear off. Molded by Holyoke Plastics Company, Holyoke, Mass., for Landers, Frary & Clark, New Britain, Connecticut.

For more complete information on these and other Cyanamid Plastics, send for the latest copy of our catalog, "*Molding Compounds and Resins.*"

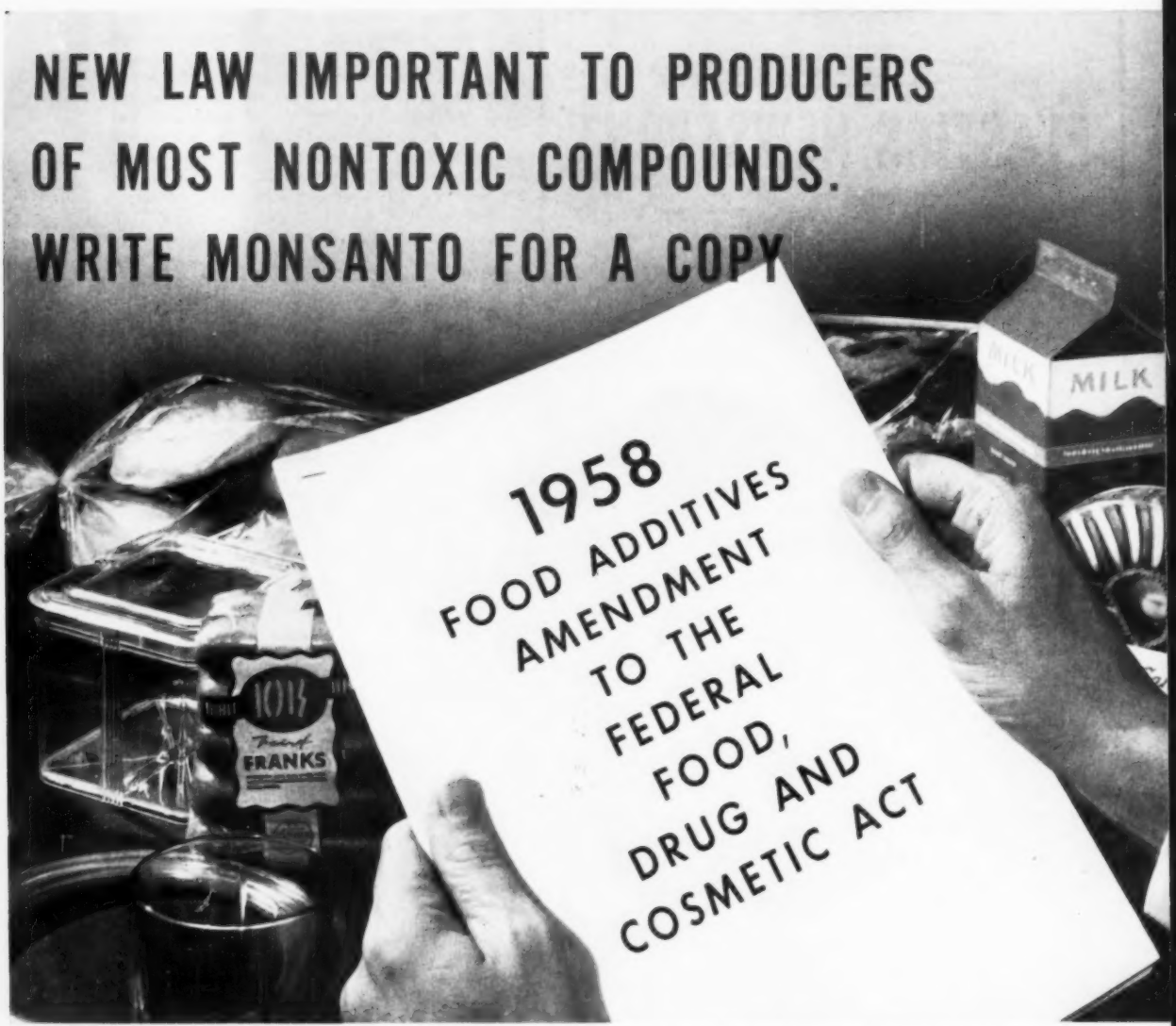
New polyester resin from Cyanamid
LAMINAC® Resin 4106 for dual-spray applications

Cyanamid's new polyester resin, LAMINAC 4106, is rigid in type, with medium reactivity and low thixotropic viscosity. It is made especially for application by dual-spray methods. When so used, the resin is divided into two portions, one containing catalyst, the other promoter, both of which are stable until mixed as converging streams enter the mold. Low viscosity and slightly thixotropic characteristics promote rapid wetting of glass fibers and freedom from sagging on vertical molded surfaces. Cure is rapid, permitting production of multiple parts per day from a single mold.

TYPICAL CHARACTERISTICS-LAMINAC 4106

Viscosity*	5 poises
Specific gravity	1.1
SPI cure characteristics	
Gel time	3½ minutes
Time to peak temperature	5½ minutes
Peak exotherm temperature	400°F

*Brookfield Model RVF, spindle #1, 10 rpm 77°F



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Five Monsanto plasticizers—Santicizer 141, Santicizer E-15, Santicizer B-16, Monsanto di-isobutyl adipate and diethyl phthalate—have earned *complete acceptance* from the Food and Drug Administration for use in plastic packaging for aqueous, fatty or nonfatty foods. By specifying these plasticizers, you can be more certain your compounds are safe and meet fully the requirements of the 1958 Food Additives Amendment to the Federal Food, Drug and Cosmetic Act.

For a quick start to solving your problem in a plastic application having nontoxic considerations, check the tables shown here. They're a convenient guide to industry's largest and most diversified line of plasticizers for nontoxic formulations . . . from Monsanto. Write for more details, samples, and compounding help today.

PLASTICIZER COMPATIBILITY WITH SIX PLASTIC MATERIALS

Monsanto Plasticizers	Polyvinyl Chloride	Polyvinyl Acetate	Cellulose Acetate	Ethyl Cellulose	Acrylic Type	Nitrile Rubber
Santicizer 141	C	C	SC	C	C	C
Santicizer E-15	C	C	C	C	C	—
Santicizer B-16	C	C	LC	C	C	C
Di-isobutyl Adipate (DIBA)	C	C	I	C	C	C
Diethyl Phthalate	LC	C	C	C	C	C
Dioctyl Phthalate (DOP)	C	SC	I	C	SC	C
Di-isoctyl Phthalate (DIOP)	C	SC	I	C	SC	C

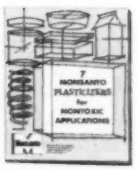
C (Compatibility)—25-100 pts. per 100 parts resin. LC (Limited Compatibility)—10-50 pts. per 100 parts resin
SC (Slight Compatibility)—1-25 pts. per 100 parts resin. I (Incompatible)

JOB-RATED PLASTICIZER PERFORMANCE (WHERE "1" IS BEST, BASED ON TYPICAL RESULTS)

Monsanto Plasticizer	Non-Toxicity	Low Volatility	Grease & Solvent Resistance	Water Resistance	Low Temperature Flexibility	Low Cost
Santicizer 141	1	1	1	2	2	1
Santicizer E-15	1	4	1	3	3	2
Santicizer B-16	1	2	2	3	3	2
Di-isobutyl Adipate (DIBA)	1	3	2	3	1	2
Diethyl Phthalate	1	5	1	2	3	1
Dioctyl Phthalate (DOP)	X	1	3	1	2	1
Di-isoctyl Phthalate (DIOP)	X	1	3	1	2	1

X—Accepted for use with foods of high water content only.

NONTOXIC PLASTIC APPLICATIONS



NEW BOOKLET NOW AVAILABLE

Gives specific advantages in numerous applications, describes outstanding features and lists specification properties of seven Monsanto nontoxic plasticizers. For your copy, use the convenient coupon.

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MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Plasticizer Dept. 2, St. Louis 66, Missouri

Please send the new booklet, "Seven Monsanto Plasticizers for **Nontoxic** Applications" plus a copy of the 1958 Food Additives Amendment to the Federal Food, Drug and Cosmetic Act.

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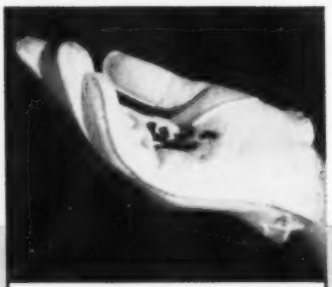

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performance variations due to resin or plasticizer or filler are minimized...

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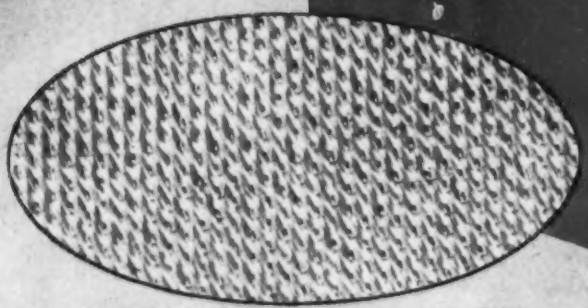

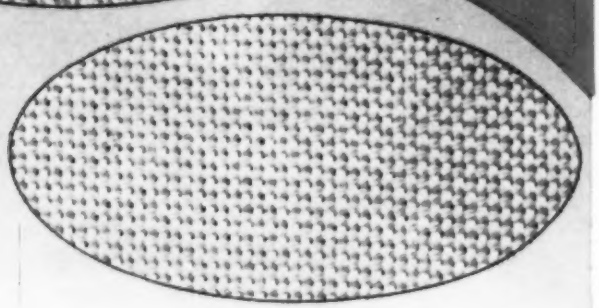

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HEAT STABILITY OF PVC RESIN FORMULATED WITH DIFFERENT PLASTICIZERS

PLASTICIZER	Parts Per Hundred Parts of Resin	Heat Stability 2 hrs. @ 350°F.	Approx. Relative Cost* (Isosebacates = 100)
DIOIS (Diisooctyl Isosebacate)	50 60	Excellent Excellent	100
DOIS (Di-2-ethylhexyl Isosebacate)	50 60	Excellent Very Good	100
DOS (Di-2-ethylhexyl Sebacate)	50 60	Very Good Very Good	135
DIOS (Diisooctyl Sebacate)	50 60	Very Good Very Good	135
DOZ (Di-2-ethylhexyl Azelate)	50 60	Very Good Very Good	105
DOP (Di-2-ethylhexyl Phthalate)	50 60	Very Good Good	65
DIOZ (Diisooctyl Azelate)	50 60	Good Good	105
DOA (Di-2-ethylhexyl Adipate)	50 60	Fair Fair	90
DIOA (Diisooctyl Adipate)	50 60	Fair Fair	90
ODA (n-Octyl-n-decyl Adipate)	50 60	Fair Fair	90
DIDA (Diisodecyl Adipate)	50 60	Poor Poor	90

Formulations:	Parts	Parts
PVC	100	100
Plasticizer	50	60
Stabilizer A	2	2
Stabilizer B	1	1

* Based on Aug. 1958 prices for finished plasticizers.

You get top heat stability at low cost by plasticizing vinyls with esters of ISOSEBACIC® acid

Dioctyl and diisooctyl esters of ISOSEBACIC® acid excel over the commonly used sebacates, azelates, adipates and phthalate as heat-stable plasticizers for vinyl resins.

The above table of data from a series of comparative tests shows the outstanding heat stability of Isosebacates. In these tests, samples were cut from sheets of various polyvinyl chloride formulations prepared by standard milling and pressing techniques. Four sets of each were heated at 350°F., with one set removed at each half-hour interval over a two-hour period. Stability was rated according to the degree of discoloration.

DOP was included in these tests since it is often used in blends to increase the compatibility of other plasticizers.

Key to Quality

To manufacturers of such vinyl products as luggage, auto seat covers, handbags, shower curtains, garden hose and footwear, heat stability is a vital property. With ISOSEBACIC acid-derived plasticizers, they get top heat stability—and good color, odor, low-temperature flexibility, and resistance to oil and soapy water extraction as well.

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ISOSEBACIC acid is a mixture of three C-10 dibasic acids—2-ethyl suberic, 2,5-diethyl adipic and sebacic acids. It is a new U.S.I. organic intermediate being evaluated for polyamides, polyesters, polyurethanes and alkyds as well as vinyl plasticizers.

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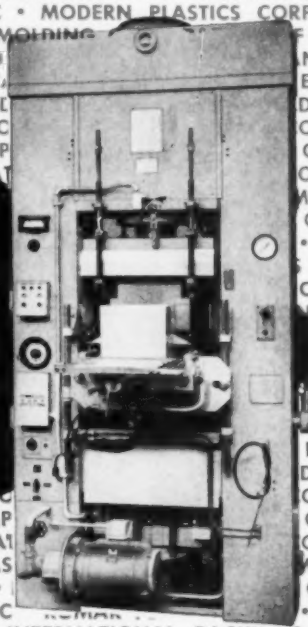

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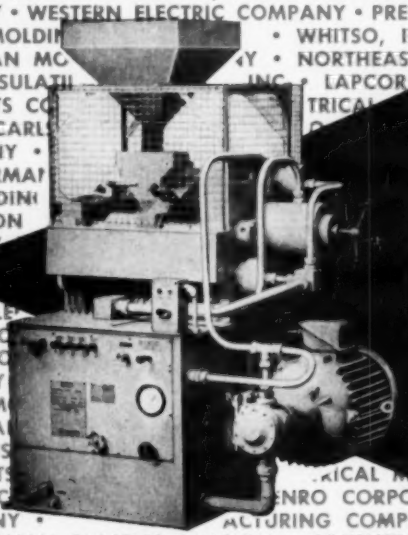

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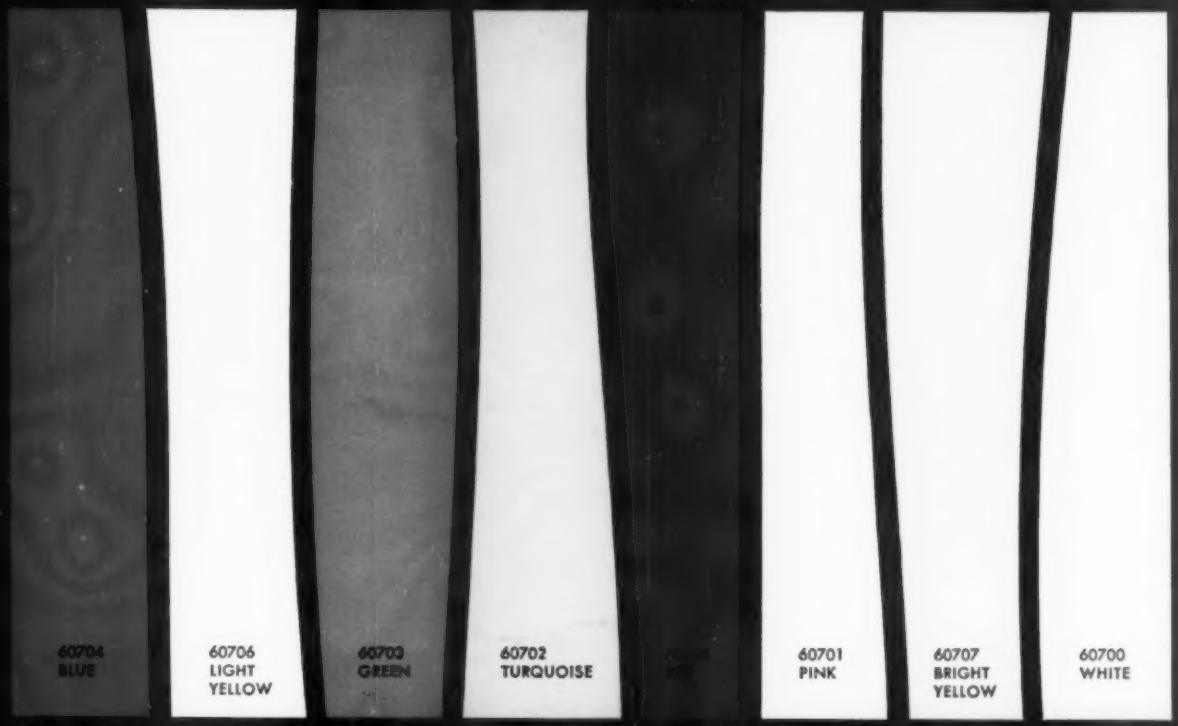

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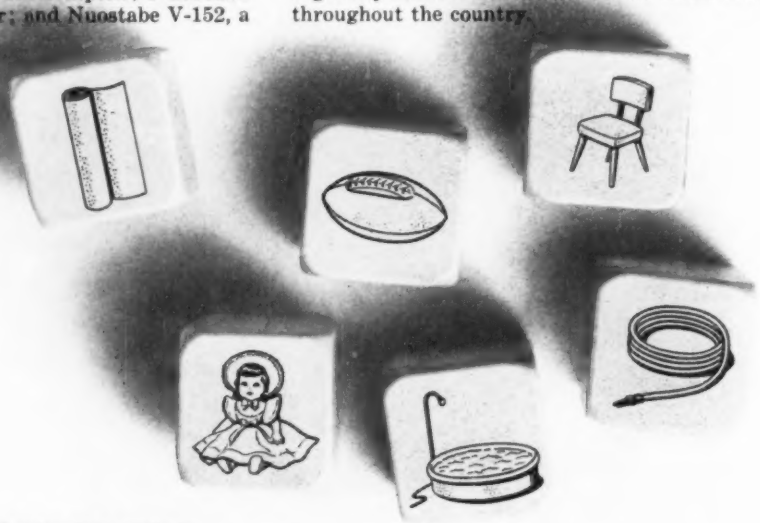

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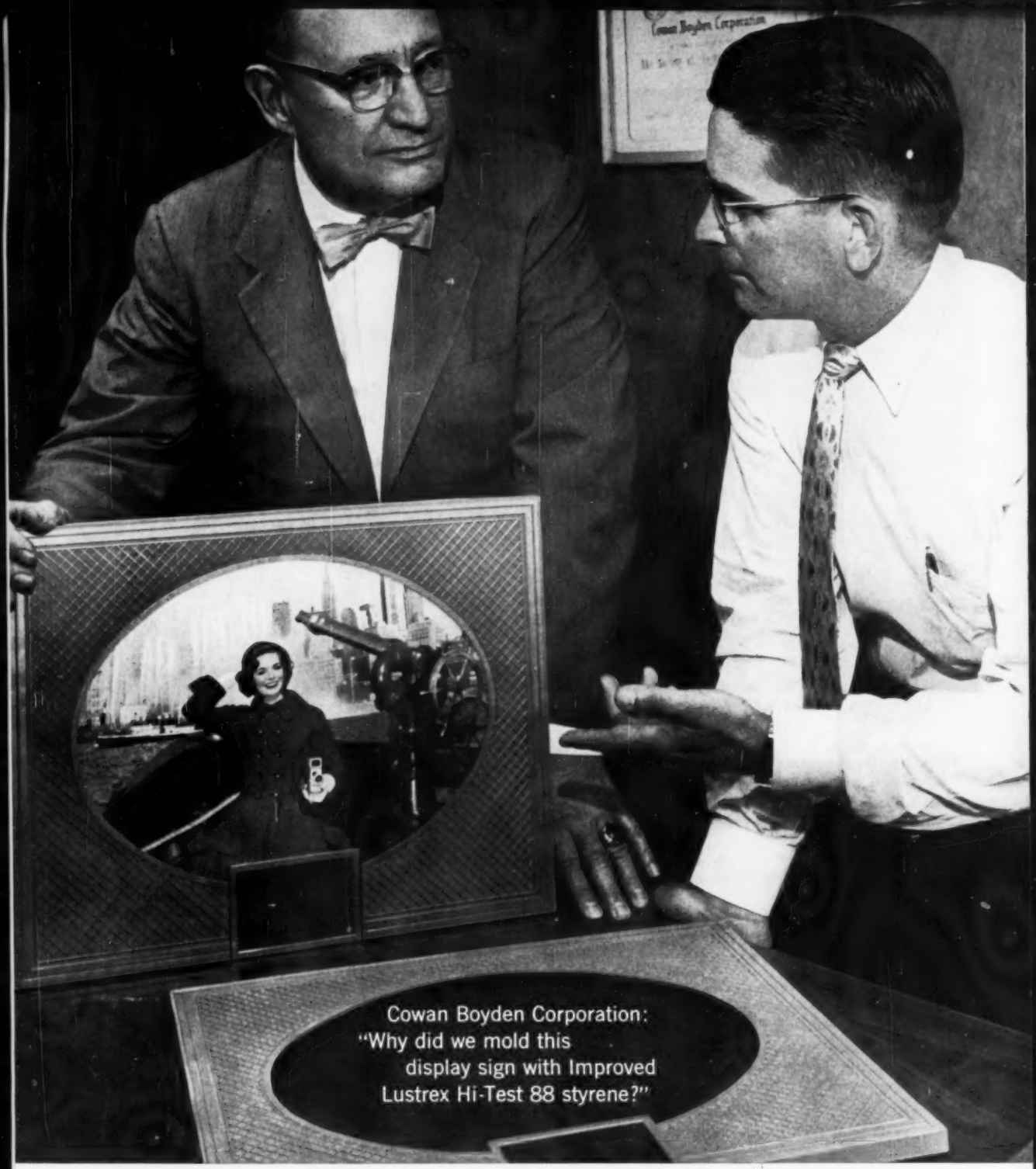

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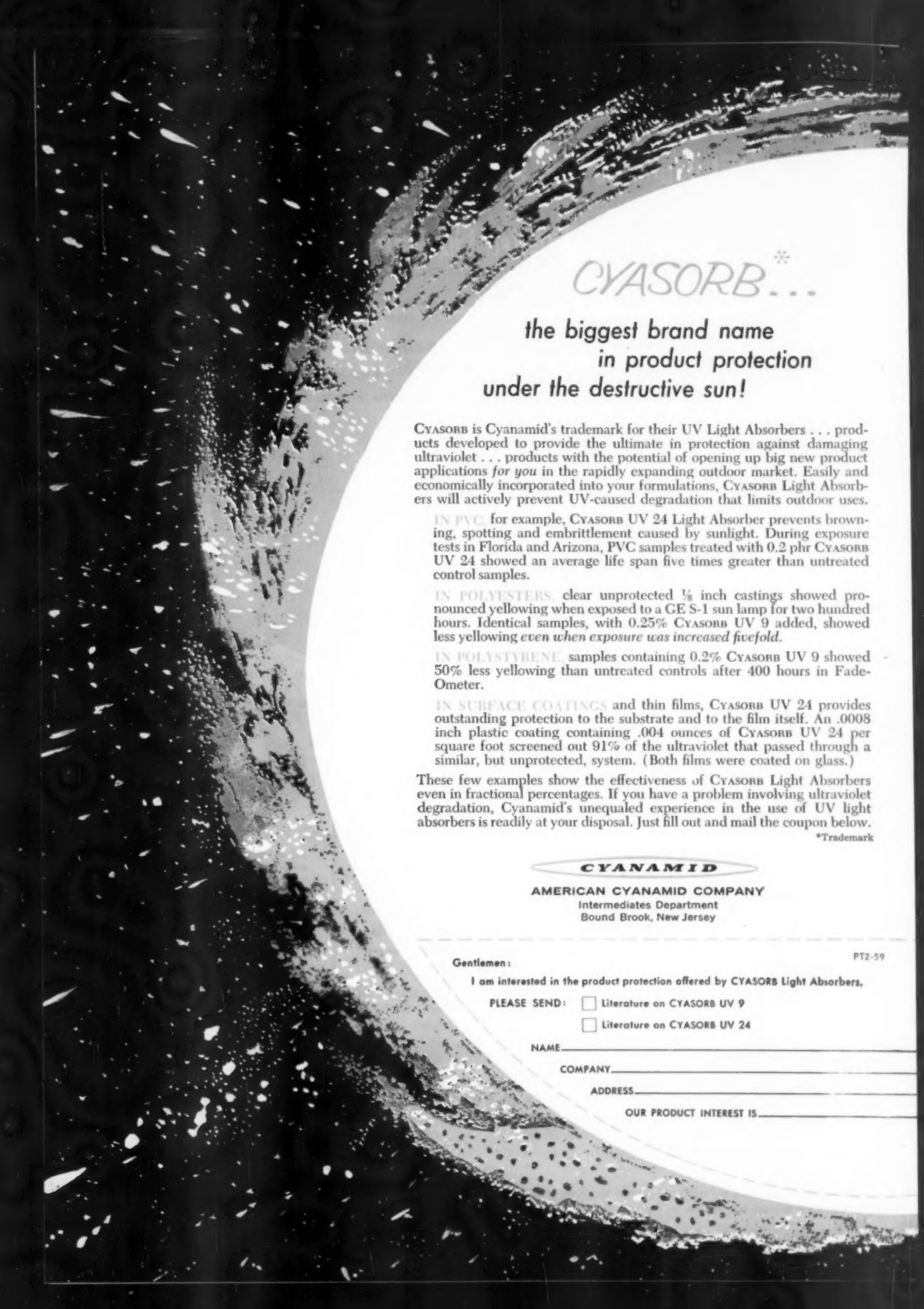

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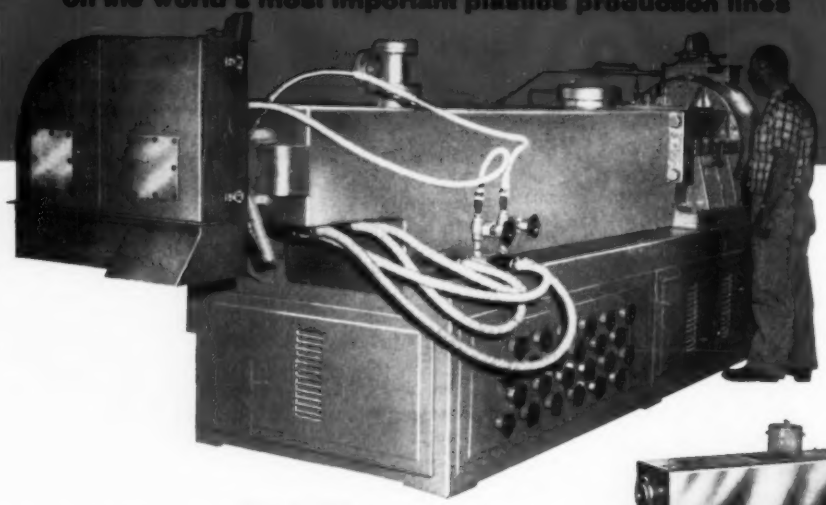

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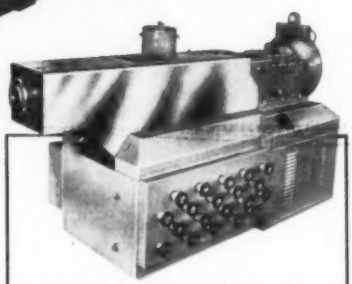

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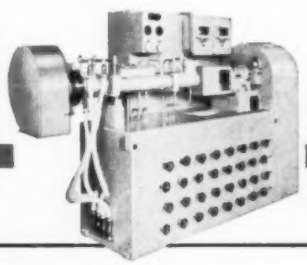

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PLASTICS
TECHNOLOGY

Environmental Stress-Cracking Resistance of High-Density Polyethylene

The factors influencing environmental stress-cracking of injection-molded linear polyethylene are discussed in detail.

F. H. McTIGUE, *Research Chemist*
Hercules Powder Co.
Wilmington, Del.

IT has been known for some time that when molded or extruded forms of the branched-chain, low-density polyethylenes are stressed in certain media (such as surface-active agents, oils, and organic acids), cracks may develop (1)*. This behavior, generally known as "environmental stress-cracking", is of particular significance in the fields of containers, pipe, and wire and cable. Substantial progress has been made in improving the resistance of the low-density polymers (1,2).

When the newer, high-density ethylene polymers were introduced in 1955, it was found, not unexpectedly, that these, too, were susceptible in varying degrees to the same type of failure. In the course of development work with the Hi-fax# series of ethylene polymers produced by modifications of the Ziegler process (3), studies were made to obtain a better understanding of stress-cracking and to devise means for improving resistance to such attack.

Stress-Cracking Test Method

The test method for the evaluation of stress-cracking characteristics of polyethylene, as worked out at Bell Telephone Laboratories, is widely used in the trade. Since 1955, it has been under consideration by ASTM as a "proposed method of test". The subcommittee concerned with the test has reported (4) that the procedure is not yet "capable of giving precise, universally reproducible values. Major causes of this appear to be the problems of reproducing test sheets, standardizing

*Numbers in parentheses refer to bibliography at end of article.
#A registered trademark of Hercules Powder Company.

the geometry of the test specimen." The method is useful for showing relative performances among polymers of the same basic type, and is believed to be reliable when comparisons are confined to materials prepared within a given laboratory.

The test, as originally developed, was for plastics having much lower moduli than the high-density polyethylenes. Thus, the stresses resulting from the bending of the test specimens to a given diameter are much greater in the more rigid materials than in low-density polyethylenes. Nevertheless, the method has proved well suited to the type of work described in this paper.

The essential features of the test method are as follows: test specimens, cut ½ by 1½ inches from a compression molded sheet 0.125-inch thick, are annealed in boiling water for 30 minutes, and conditioned for at least 24 hours at room temperature. A longitudinal slit, ¾-inch long and 0.020 to 0.025-inch deep, is cut in the center of each piece with a razor blade. The slit pieces then are bent, and placed in a brass channel jig having an inside width of 0.463-inch. A total of 10 specimens from the same plastic sheet are placed in the jig which, in turn, is placed in a large test tube. The jig and test pieces are covered with the full strength, non-ionic, surface-active agent, Igepal CO-630, and the entire assembly is placed in an oil bath maintained at 50° C.

The pieces are observed periodically, and the time at which 50% of the specimens have failed (F_{50}) is the stress-cracking time. Failure usually is indicated by the development of cracks perpendicular to the slit in the piece and near the peak of the bend.

Table 1. Resistance of Hi-fax to Stress Cracking in Igepal at 50° C.

Reduced Specific Viscosity (RSV)	F_{50} Hours
2.3	20
2.6	20
3.2	144
4.1	650
5.1	>2,000
6.3	>2,000

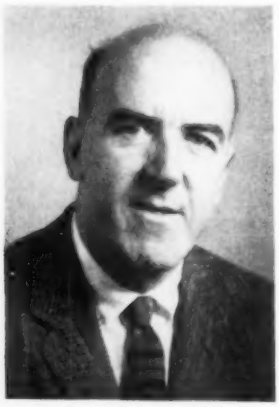
Effect of Molecular Weight

The above test was applied to study the effect of polymer chain-length on the stress-cracking resistance of a series of Hi-fax polymers. Solution viscosities (routine criteria of molecular weight in the Hercules laboratories) were measured on 0.1% solutions of polymer in Decalin at 135° C. The specific viscosity divided by the concentration is called the "reduced specific viscosity" or RSV. Figure 1 shows the relationship of RSV to weight-average molecular weight, as determined by light scattering. The molecular weight as a function of intrinsic viscosity, $[\pi]$, also is shown in this figure.

The Hercules-Ziegler polymerization process is capable of producing a wide range of polymer-chain lengths. The general-purpose Hi-fax polymers, Types 1400 and 1600 (see Figure 1), are recommended for injection molding and many extrusion applications. These are in the range of RSV 2-3, corresponding to weight-average molecular weights of 125,000-230,000. They have F_{50} values of 20 to about 120 hours in the Igepal test.

Use of polymers at the RSV level of 4.5-6 (Hi-fax Type 1800, with a weight-average molecular weight value of 400,000-570,000) has provided stress-cracking resistance well beyond 2,000 hours. Because of the time-consuming nature of this test, exposures generally have been terminated at 2,000 hours; but, on occasions, have been allowed to continue as long as 3,500 hours. Our experience with various RSV levels in the Igepal test is summarized in Table 1.

Melt index (weight, in grams), of polymer extruded through an orifice of prescribed dimensions at 190° C. under a load of 2,160 grams (ASTM D-1238) is used widely in polyethylene technology to represent differences in flow. Because melt index is affected by molecular weight (i.e., the higher the molecular weight, the lower the melt index), the molecular weight differences shown in Table 1 can be related also to melt index. The values fall in the range of 0.4 for the lowest molecular weight (RSV 2.3) to less than 0.01 for the highest molecular-weight materials shown. However,



Frank H. McTigue was born in Holyoke, Mass., in 1919. He received an A.B. in Chemistry from Williams College in 1941, and a Ph.D. in Organic Chemistry from Yale University in 1949. From 1941-1942, he was a chemist for the Plastics Division, Monsanto Chemical Co. From 1942-1946, he was a meteorological officer in the Naval Reserve, and now holds the rank of Lt. Commander U.S.N.R. Following his military duty, he was graduate assistant in chemistry at Yale University from 1946-1949. He came with Hercules Powder Co. in 1949 in his present capacity as Research Chemist, and has worked in polyolefin development since Hercules' entry into this field. His field of work has included property-structure relationships, stabilization, and applications development, and he is now in charge of polyolefin applications development and evaluation at the Hercules Research Center in Wilmington, Del. He is an active member of SPE and ACS.

Mr. & Mrs. McTigue have two children and reside in Foulk Woods, Wilmington, Del.

since melt index measurements as low as 0.01 are difficult to duplicate, solution viscosity is more useful for specifying these grades. Despite the low melt index values for the higher molecular weight materials, these grades of polyethylene extrude satisfactorily at the temperatures and shear rates used in commercial equipment.

Level of Stress and Strain

Another variable in the evaluation of environmental stress-cracking resistance is the thickness of test specimens. This is particularly important because it affects the degree of strain developed in the surface layers of the piece when it is inserted in the standard brass channel. The degree of bending encountered in industrial applications varies widely and, for most uses, will be much less than in the standard test. For this reason, we were interested in determining performance at the lower levels of bending encountered in cable or pipe applications, and in knowing if the advantages of the higher molecular-weight polymers would be retained over a wide range of strains.

The relationship between sample thickness and elongation produced at the ouside of the curvature of the bent piece is shown in Figure 2. This is based on assumptions that the piece takes a semi-circular shape with an outside diameter equal to the width of the inside of the brass channel, and that the cross-section remains constant in shape and area. These conditions, of course, are only approached in the stress-crack test procedure as usually conducted, but the graph is useful in providing relative data on the strains involved. The graph shown in Figure 2 also relates the yield point of Hi-fax and low-density polyethylene to the elongations encountered in the test. As shown, yield values for these polymers are within the elongations involved in the test.

The relationship described in the graph shows that most bends in cable or pipe involve surface elongations in the order of 1-3%. To achieve an elongation as high as 10% on a ⅜-inch thick cable, it would be necessary to bend the cable on a 3⅜-inch diameter. For a ¾-inch cable, a bend with a 6¾-inch diameter would be required. It is apparent, therefore, that the strain imparted to the ⅛-inch thick test specimen, about 37%, would not be encountered in most pipe and cable constructions. However, the higher levels of strain are important and would be encountered in work with small wires where it is necessary to wrap the insulated conductors around themselves. To examine the effects of lower levels of strain, samples representing

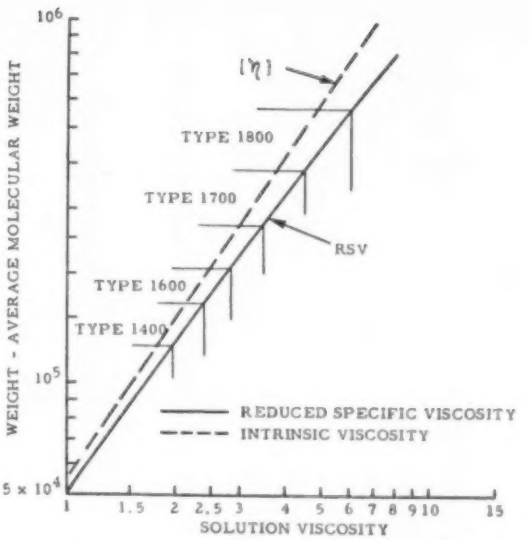


Fig. 1. Viscosity-molecular weight relationship for Hi-fax resins.

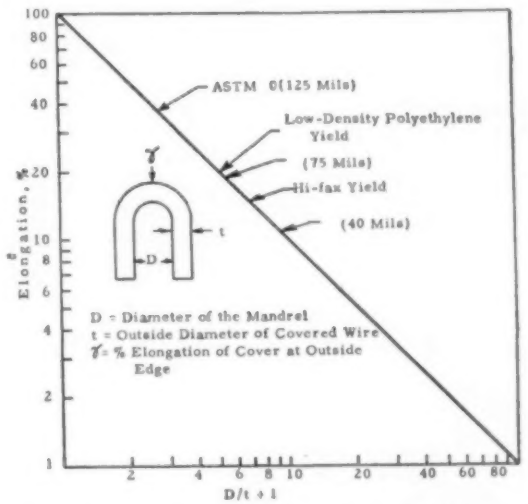


Fig. 2. Elongation as a function of coating thickness and bending radius.

Table 2. Properties of Butyl-Modified Hi-fax*.

RSV	2.6	2.6	4.1	4.1	4.1	5.1
Butyl rubber concn.	0%	20%	0%	10%	20%	0%
F_{50}, hrs., in Igepal at 50° C.	20	>2000	650	>2000	>2000	>2000
Tensile strength, psi.	3,500	2,300	3,060	2,500	1,900	3,050
Flexural stiffness, psi.	97,000	71,000	100,000	70,000	60,000	89,000
Elmendorf tear strength, grams/mil	40	125	64	113	—	137

*All compounds contain 2% channel black and an anti-oxidant.

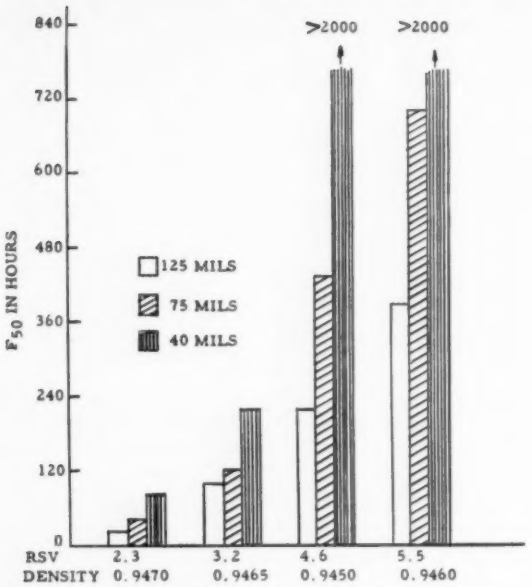


Fig. 3. Stress-cracking of Hi-fax in 0.5% Igepal at 50° C.

a range of thicknesses were investigated.

In addition to the standard Igepal, two other media were used that were shown previously to be effective in producing stress-cracking in even shorter periods of exposure. These were: (a). a 0.5% solution of Igepal CO-630 in water at 50° C.; and (b). distilled water at 90° C. Samples of unpigmented polymers having four different RSV values were tested at three thicknesses; 125, 75, and 40 mils.

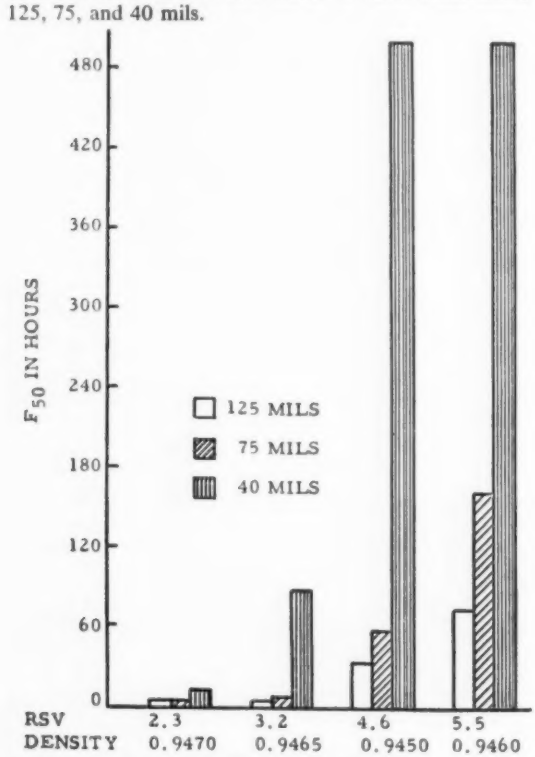


Fig. 4. Stress-cracking of Hi-fax in Distilled Water at 90° C.

The effect of sample thickness on cracking resistance in 0.5% Igepal at the various RSV levels is shown in Figure 3. As anticipated, F_{50} values were extended substantially by reducing the specimen thickness. The superiority of high-viscosity materials again is observed.

Data obtained in distilled water at 90° C. are summarized in Figure 4. Life is considerably shorter than for the conditions of Figure 3, but again we see the beneficial effect of high viscosity and that this advantage is retained over the range of thicknesses.

We interpret the more rapid failures in the hot-water bath to be due to the greater tendency of the polymers to recrystallize at higher temperatures. This can be visualized as mainly a physical, rather than oxidative, effect. Polymer chain ends may be removed from crystallites and regrouped either in amorphous regions or in nearby crystalline areas in a manner such that the resulting structure is weakened. This weakening would be accelerated by the combination of stress and increased temperature. The longer the chains (i.e., the higher the RSV) and the lower the stresses, the less chance there will be for such ruptures.

It has been suggested that the phenomenon observed in hot water may more correctly be termed "thermal embrittlement" than environmental stress-cracking. There probably are elements of both effects present. Since the same type of response to higher molecular weight and reduced strain is obtained here as in the 50° C. Igepal tests, it seems reasonable to include these observations in the present work.

Finally, Figure 5 shows the effects of thickness and molecular weight on life in the more conventional medium, 100% Igepal at 50° C. At the two higher RSV levels, all thicknesses satisfy the 2,000-hour requirement. At RSV 2.3 and 3.2, the thinner specimens, as would be predicted, show an improved stress-cracking resistance.

Performance of Injection Molded and Extruded Articles

Since it has been established that the degree of strain imparted to specimens in the stress-cracking test has an important influence on resistance, in view of the above results, the behavior of several articles fabricated by commercial methods was studied.

A group of injection molded bowls, 8½ inches in diameter, 4¼ inches deep, and 0.085-inch wall thickness, made from Hi-fax of RSV 2.5 was tested. Applying the ASTM-Bell procedure, specimens ½ x 1½ inches were cut from the side of a bowl, some parallel and some perpendicular to the direction of plastic flow in the molding (the mold had been center-gated in the base). Specimens were bent, placed in the standard brass jigs, and immersed in water at 90° C. and in concentrated Igepal at 50° C.

Under these stress conditions, more severe than could be encountered in use, the sections cut parallel to the flow failed in about 48 hours in hot water, while those cut perpendicular to the flow lasted six hours. In Igepal, the parallel pieces were unaffected after 1,000 hours, while the perpendicular pieces failed in about 20 hours. These results indicate that there was considerable anisotropy of structure in the walls of

these bowls, with orientation in the direction of flow in the molding.

To see how these observations relate to more practical types of exposure, a number of bowls, both stressed and unstressed, were immersed in various liquids. One group was exposed in the "as molded" form, while another group was clamped in a manner so that one diameter was reduced to 80% of its original size. In the latter case, the applied stress is perpendicular to the flow direction. Samples from each group were immersed at 90° C. in water, 0.5% Igepal CO-630 solution, 1.0% Tide solution, and 1.0% Ivory Snow solution. Only near the end of the second week of continuous immersion did one failure occur (the stressed bowl in Ivory Snow solution). No other pieces had shown evidence of cracking when the tests were terminated after 19 days.

In another practical demonstration of stress-crack resistance, samples of one-inch schedule 40 pipe extruded from Type 1600 Hi-fax showed no failures in the test proposed by SPI (5). In this test, the pipe is stressed at an air pressure of 270 psig at 75° F. (twice the recommended working pressure), the surface painted with Igepal, and the conditions maintained for three hours. In practice, there was no evidence of cracking after 24 hours, at which time the test was terminated.

Effect of Rubber Additives

Another approach to increased stress-cracking resistance is through compounding with elastomers. Polyisobutylene (Vistanex 80) and butyl rubber (GR-I 17) appeared equivalent in their effects on high-density polyethylene in screening tests, and attention was concentrated on the more economical product, the butyl rubber. Table 2 shows the properties of various blends of Hi-fax at different RSV levels with butyl. All contain carbon black and anti-oxidant.

Use of 20% rubber in the low-viscosity type and 10% in an RSV 4.1 polymer gave 2,000-hour life in Igepal at 50° C. Compositions of this type also gave 2,000-hour resistance in the 90° C. water exposures. No doubt the elastomer functioned to lower stresses in the polymer, thereby improving cracking resistance. Incorporation of the rubber makes the compound softer, and lowers the modulus and tensile strength values. It also tends to increase extrusion rates, acting as a plasticizer. Toughness, as shown by Elmendorf tear resistance on a thin sheet (eight mils thick), also was increased by the additive.

Conclusions

Resistance to environmental stress-cracking is an important consideration for applications of high-density polyethylene when exposure to certain media may be encountered. Factors favorable to increased resistance are: (1). high molecular weight; (2). reduction of stresses by proper molding; and (3). incorporation of elastomers in the plastic formulation. The first and third factors have been applied particularly to the extrusion operations of pipe and coated-wire manufacturers. The second factor, through proper mold design and choice of optimum temperatures and molding cycles, has played an important part in injection molding.

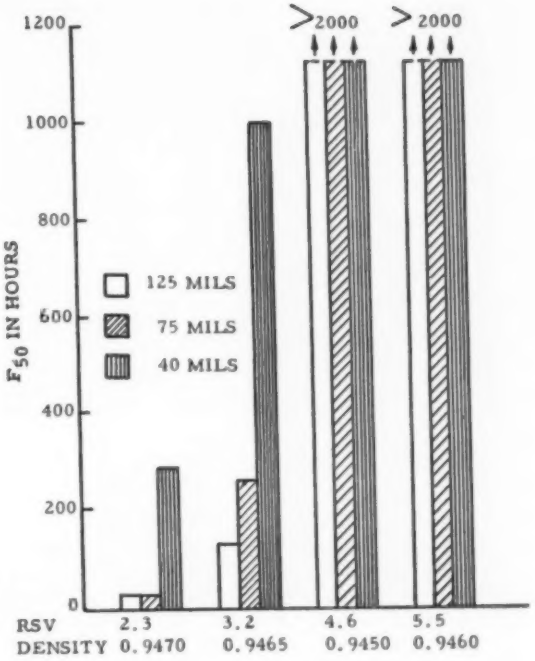


Fig. 5. Stress-cracking of Hi-fax in 100% Igepal at 50° C.

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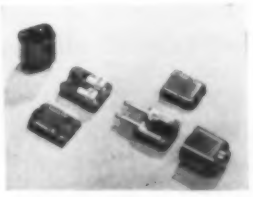

Molded-in nylon connectors.

Snap-Fit Nylon Connectors

Miniature connectors for Air Force helmet earphones are being molded from nylon by Fluorocarbon Products, Inc., Camden, N. J. The material's elasticity permits a rapid, snap-fit. A molded groove in each half of the body assembly mates with a companion bead, molded inside the shell. Combined weight of male and female connector set is but 0.053 ounce.

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Making Trailer Bathtubs of Reinforced Polyester With Urethane Foam Bases

Bathtubs of glass-reinforced polyester with foamed-in-place urethane bases are shown to have many advantages over conventional tubs.

WHETHER due to frequent job relocation, lack of local accommodation, or just plain "wanderlust", some 100,000 mobile homes are sold each year. Many of these homes, especially the larger and more luxurious models, are as well equipped as a city apartment offering all of the latter's advantages without two of its largest disadvantages—the monthly rent and taxes.

Trailer products and facilities all must meet certain basic requirements: They must be attractive and "homey"; they must be light in weight so as not to add too much to the load to be hauled; they must be sturdy to withstand road shocks and constant vibration; they must be compact to conserve premium space; and, perhaps most important they must be reasonable in installation and maintenance costs.

A fiberglass-reinforced bathtub, produced by this company, meets all of these requirements, although it took quite of bit of development work to do it. The finished tub is a good example of how two types of plastic—reinforced-polyester and urethane foam—can

complement each other to achieve a more satisfactory end-product.

Molding of Tub

Bathtubs are molded by taking a preformed shape of glass mat and placing it over a male metal mold. The polyester resin is poured onto the shape, and the press closed for a low-pressure cure cycle of about five minutes at 225° F. Using several presses, each with a different-sized mold, the operation is capable of delivering well over 400 reinforced bathtubs per week.

After molding, tubs are inspected and trimmed (see Figure 1), drainage holes are drilled. At this point, the tub has a round bottom, making it very difficult to mount the tub securely on the trailer floor. Suspension mounting from the side flanges of the tub was tried initially, but found unsatisfactory for two reasons. Firstly, such mounting placed the entire weight of the person using the tub on the flanges, which would have to be very heavily reinforced. Secondly, although the tub certainly is strong enough to hold the weight of any user, it might flex slightly when the user is getting in. This was found to be a psychological handicap, making the tub *seem* unsafe.

Easy Mounting, Solid Feel

The problem of mounting the tub was solved successfully after many trials, by means of a Nacconate* resin-based urethane foam. In effect, the tub now nests in a two-inch layer of urethane foam which not only gives it a level support, but also insulates the bottom of the tub to keep the water warm. This application of the foam to a fiberglass-reinforced plastic bathtub is a patented process.

The advantages of rigid urethane are that it can be foamed-in-place, and that the foam acts as its own best adhesive. Urethane will adhere even to polyester, a material which usually is very difficult to bond.

Each molded polyester tub is mounted upside-down on a special fixture (see Figure 2) at a slight angle to provide drainage when tub later is installed in its upright position. A special collar assembly, to confine the flow of foam and help shape it, is placed in position and the drainage hole is plugged to keep foam from closing it.

Some 150 grams of Nacconate 1080H isocyanate are stirred quickly into 100 grams of polyester premix (see Table 1), either by hand or an electric mixer. After a few seconds of agitation, the formulation is poured into the collar assembly (see Figure 3) and the press cover is lowered. To assure complete fill of all voids and a perfectly flat bottom, a slight excess of formulation is poured into the cavity. The cover of the fixture is held down by air pressure, to compensate for the forces exerted by the expanding foam.

Curing of the foam takes place by its own exothermic reaction and, in 10 minutes, the foam is hard enough to permit removal of the molding collar (see Figure 4). Two sheets of wax paper, which were draped over the collar before pouring began, facilitate parting. Without them the foam would adhere to the steel collar.

*Trade mark of Allied Chemical Corp.

Fig. 1. Plastic tub after molding is trimmed with saw and checked carefuly for flaws. After drilling the drain hole, tub is ready for foam base.

Fig. 2. Tub is mounted on press at slight tilt to allow for drainage, then collar to shape urethane foam base is fitted over the tub.

Fig. 3. Urethane mix being poured into the molding collar, ready for foaming. Top of fixture (upper right) is pulled down over collar, and pressure is applied to insure flatness of tub-and-foam-base bottom.

Table I. Formulation of Urethane Foam

Component	Function	Weight, Gms.
PFR-5 polyester resin	Primary component	100
Water	Gas generator	3.5
Witco 77-86	Emulsifier	1.0
Santocel	Thickener	2.0
n-methylmorpholine	Catalyst	1.0
(The above are stirred together; no reaction will take place.)		
Nacconate 1080-H resin	Primary Component	150
(When this component is added, and the mixture stirred, foaming will start. The reaction is complete in about one minute.)		

The entire foam-in-place sequence is surprisingly simple and, because it is fairly fast, is best followed-through by one man. Once the operator becomes adept at judging the mixing and pouring time, the resultant foams are reliably uniform in quality. A good bottom molding requires practically no trimming, no prior preparation, no after-finishing, and results in very little waste. After foaming, the tub is given a quick final inspection, and then is ready for packaging and shipment.

Finished Tubs

Urethane foam offers several benefits for the buyer of plastic trailer tubs. The foam has a very low density (about three pounds per cubic foot), adding very little weight to the finished product. The 46½-inch model, for example, weighs only 18 pounds, so that it is handled easily by one man during installation. For the same reason, shipping weight (and charges) are reduced, resulting in another saving.

Furthermore, the urethane foam attenuates sound, thus reducing bathroom noises. In addition, the tub feels warmer than would one made of metal. Another advantage of the urethane foam base is that it simplifies installation. The tub is placed flat on the floor and automatically presents the correct pitch for proper drainage. A tedious juggling, shimming, and alignment problem has been eliminated completely.

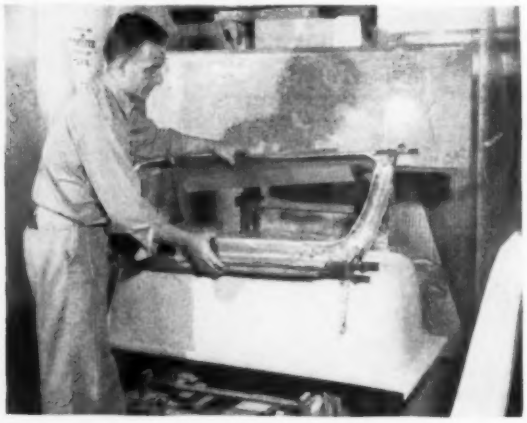


Fig. 4. Collar is removed after urethane has been foamed-in-place. The foam adheres well to polyester tub, and becomes a permanent part of the tub.

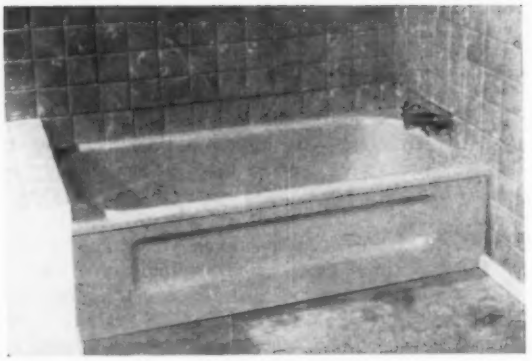
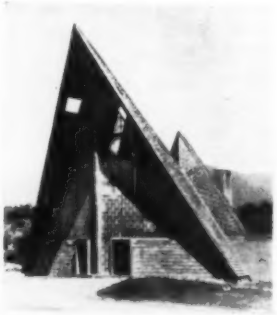


Fig. 5. Completed plastic tub with urethane foam bottom is ideal for trailers, but also can be installed in permanent homes.

Tubs are available in two sizes; for either left or right entry; in many decorator colors. Production costs for the all-plastic tub are noticeably less than those of the conventional vitrified steel variety. In addition to lower initial cost, the tub also is less costly to maintain. It is chip-proof, the finish will not peel, and the surface of the tub is easy to clean. Household solvents and chemicals will not harm it; even nail polish, iodine, mercurochrome, and similar stains are removed easily.

The all-plastic tub has proved itself in both trailer and home service (see Figure 5). Lay-up techniques are well established and relatively fool-proof, and foaming-in-place is the quickest, cheapest, and most compatible method we have found so far for a base. With approximately 15,000 bathtubs installed in the past three years, not a single major problem with the base molding has been noted. —THE END



Church sides are translucent plastic glazing.

Church Uses Plastic Glazing

Translucent fiberglass-reinforced polyester panels are used for the exterior walls of St. Gregory's Church Woodstock, N. Y. Lightweight (1.75 pounds per square foot), they have a good insulation factor. Supplier is Kalwall Corp., Manchester, N. H.

Guest Editorial

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DeBell & Richardson, Inc.
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. . . But Never Plastics Engineering!

IN the past five years, I have had the occasion to work with a great many high school students both in the East and in the Midwest. In this connection, the encouragement of youngsters to go to college has been an important factor of this association. Whenever a youngster has decided to enter the engineering field, he has always been asked what kind of engineering he wants—and in every case, bar none, he has mentioned the traditional engineering fields—mechanical, electrical, industrial, and chemical, BUT NEVER PLASTICS ENGINEERING.

As a member of the plastics profession, I find this very disconcerting and alarming since we need trained plastics technologists in our field, and we need them badly. We are all aware that plastics are taking an important role in the over-all industrial picture, and that our industry is growing at a faster rate than is the number of trained personell available to fill the growing number of openings.

As a result, I began to explore the situation to determine what is being done in our field, and what can be done to popularize plastics and the plastics engineering profession in the eyes of today's youth.

Two of the national plastics organizations, The Society of the Plastics Industry (SPI) and The Society of Plastics Engineers (SPE) have activities in this field. It is our purpose here to encourage these activities and urge further support of them by the plastics industry and its engineers.

Basically, the problems facing us are: (1). How can we stimulate a strong desire for a career in plastics; and (2). How can we encourage more schools to include courses in plastics and make plastics degrees available?

We would suggest that a program aimed at interesting and informing young people both before and at the secondary school level would instill this desire to become a part of the plastics industry. With increased interest being shown by students, the colleges would be aware of their need for courses to fill the needs of a curriculum necessary in providing a degree in plastics engineering. This desire and interest would have the beneficial side-effect of improving understanding and acceptance of plastics both as materials as well as an industry. Already, such schools as Princeton University and Lowell Technological Intitute have felt this need and have pioneered in the provision of courses leading to degrees in plastics engineering on the graduate and undergraduate levels, respectively.

Local plastics firms can take the initiative of cultivating "their own back yards." They can exert influence on their communities and provide for programs within them. Such work, of course, is done by individuals. The national societies of the industry can lend their support to these local activities.

A specific program might include:

(1). Up-to-date bulletins available to high school students giving information as to what schools, courses, and curricula are being offered for careers in plastics;

(*Continued on page 52*)

F. N. McGARRY, *Asst. Prof. of Matls. and Supervisor, Plastics Research Lab., Massachusetts Inst. of Technology Cambridge, Mass.*

Resin Characteristics

Relating to Laminate Behavior

Mechanical properties of glass-reinforced laminates

are shown to depend on resin properties and conditions of loading.

THE mechanical behavior of fibrous glass-reinforced laminates is not well understood presently, despite wide use of the material in primary structural applications. Theoretical treatments based upon elastic theory, purely mathematical in nature, are fully developed (1)* and have been tested experimentally. In some cases, the correlation between theory and experiment has been judged adequate (2); in others, anomolous observations have suggested the need for further study (3).

Implicit in such applications of the classical treatment are certain assumptions about the adhesive and cohesive actions of the resin matrix that may not be realistic, based on the mechanical behavior of cured, unreinforced resins measured by conventional tests (4). The assumption of a Hookean or linear stress-strain response is not always valid. The contradictory neglect (in the theory) of possible interlaminar shear distortions in the resin layers between reinforcement plies may not be justified, and certainly is not consistent. Finally the assumption that the resin-glass fiber bond remains unbroken during load applications to the laminate, is open to question (5).

The purpose of this paper is to discuss some experimental results that are felt to be significantly related to such questions, and to offer certain hypotheses which the results suggest.

Component Properties

To be discussed are two rigid, general-purpose laminating resins, Paraplex P-43*, a commercially available polyester, and Epon 828**, a commercially available epoxy. Both resins are considered to be representative of their respective chemical classes, and are widely used in laminate production. It is recognized that some variations in their mechanical properties

*Numbers in parentheses refer to Bibliography at end of article.

* Manufactured by Rohm & Haas Co., Philadelphia, Pa.
**Manufactured by Shell Chemical Corp., New York, N.Y.

Table 1. Comparative Properties of Laminating Resins and Electrical-Grade Glass Fiber

	Paraplex P-43		Epon 828	E-Glass Fiber
Tensile Modulus, 10^6 psi.	0.59	(=)	0.60	10.5
Strength, psi.	9,000	(=)	12,300	250,000
Strain at failure, %	1.7		2.6	2.4
Comprehensive Modulus, 10^6 psi.	0.66	(=)	0.62	10.5
Strength, psi.	24,100	(=)	27,800	—
Flexural Modulus, 10^6 psi.	0.62	(=)	0.60	—
Strength, psi.	17,500	(=)	18,000	—
Curing shrinkage, Volumetric, %	7		4	—
Moisture absorption, Weight %	0.4*	(=)	0.1-0.5#	Attacked (10)
Coefficient of Thermal Expansion, x 10^{-6}/°F.	40-60	(=)	30-50	3

* ASTM D543-52 (70-day immersion).
\# ASTM D570 (24-hour immersion).

result from different polymerization agents and techniques, but the data presented in Table 1 are typical (6, 7). Also in Table 1 are data on drawn E glass (electrical grade) fibers (8), the cited tensile strength of which refers to commercial rather than laboratory production, the latter being somewhat stronger (9).

In Table 1, the resin properties denoted by (=) are essentially equivalent. The difference in strains at tensile fracture indicates a higher ductility on the part of the epoxy resin, suggesting that it can undergo a 50% greater imposed deformation without fracturing than can the polyester. Since the visco-elastic properties of the two resins while curing are not well known, the implications of the difference in volumetric shrinkage must remain in the realm of conjecture.

Table 1 suggests that similar laminates based on the two resins should possess nearly the same mechanical properties. This is borne out by data reported by Boller (11), part of which is presented in Table 2.

The epoxy laminate contained about 10% less glass, absorbed about 20% more water under 24-hour immersion, and was roughly 10% less stiff when tested dry. Considering the difficulty in controlling fabricating variables in laminate production, these differences are not considered significant. Further demonstration of the equivalence was provided by extensive data in a comprehensive evaluation of glass finishing agents (12):

From Table 3, two facts emerge: (1). the dry strengths of the polyester and epoxy laminates are approximately equal; and (2). after immersion the epoxy laminates retain greater percentages of their strength than do the polyester laminates. This latter fact is widely recognized as one of the important advantages of epoxy laminates in many engineering applications, and represents a significant difference between the two resins. It is profitable to seek the causes of this difference.

The strength of fibrous glass is reduced by contact with water (through both physical action (10) and chemical attack since it is not a chemically-inert material). In a laminate, water readily can penetrate from the surface into the interior if voids and separations between fibers and matrix exist at the glass-resin interfaces (13). Such separations or cracks, microscopic in cross-section, have been observed by Weber (14) who directly established their water transmission capabilities. They can be caused by several circumstances, as follows:

(1). Failure of the liquid resin to penetrate completely the fiber bundles and encapsulate the individual fibers. This is most likely when yarn- or roving-based woven fabrics are used for reinforcement.

(2). In cooling from the curing temperature, the thermal contractions of glass and resin differ by an order of magnitude (Table 1). This creates normal and shear stresses at the interface that cannot be calculated theoretically with any degree of certainty, but some idea of their magnitudes and distributions can be inferred from experimental studies of lap shear joints, a qualitatively similar situation (15). These indicated that such stresses are appreciable when compared with resin strengths.

(3). Stresses resulting from externally-applied loads on the laminate are distributed between resin and glass and transmitted from one to the other by shearing

Table 2. Comparison of Polyester- and Epoxy-Glass Laminates

	Polyester Laminate (Paraplex P-43 & 181 Fabric, Volan A Finish)	Epoxy Laminate (Epon 828 & 181 Fabric, Volan A Finish)
Resin content, %	34.3	37.7
Moisture absorption, %	0.09	0.11
Tensile modulus, 10^6 psi.	3.23	3.04
Strength, psi.	52,220	48,950
Compressive modulus, 10^6 psi.	3.57	3.22
Strength, psi.	43,480	58,470
Flexural modulus, 10^6 psi.	3.45	3.02
Strength, psi.	66,920	65.630

actions, analogous to the lap shear joints mentioned above. High stress concentrations are known to exist in such cases, and the possibility of resin-resin or resin-glass fractures is very likely.

Careful laminating techniques can reduce the likelihood of gross resin-starved regions in the laminate. If water immersion is carried out prior to testing, as is the usual procedure, then only the differential thermal contraction mechanism is fully operative and must in some way be responsible for the difference in epoxy and polyester laminates (as illustrated in Table 3). The reduced ductility and increased shrinkage of the polyester could combine to degrade the wet strength properties, but such a conclusion is not indisputable. However, other factors need be considered.

Thus, as the cooling shrinkage occurs, the resin may be thought of as having a tendency to peel away from the glass, its contraction being the greater. The work of Bikerman (16) points out that the peel strength of a joint depends only upon joint geometry and the mechanical properties of the adhesive and adherends involved, such as cohesive strength, Poisson's ratio, and elastic modulus. The theory applies only if a good joint has been formed; one in which wetting of the adherends by the adhesive has occurred in the absence of weak interfacial layers.

The equivalence of resin mechanical properties in Table 1 suggests that the polyester does not form as strong a joint with glass as does the epoxy breaking apart from the glass at lower levels of the stress created by the differential thermal contraction. More simply, the polyester does not stick to glass as well as the epoxy resin apparently does. More interfacial cracks form in the polyester upon cooling; the water penetration is greater; and a larger decrease in mechanical properties results.

Resin-Glass Joint Strengths

To confirm the foregoing hypothesis, a substantial number of joint strength measurements between single glass elements and a surrounding resin matrix have been carried out by three different methods (17). These involved glass cylinders over a diameter range of 0.155-0.010 inch, the larger Pyrex rods of the type shown in specimens A and B in Figure 1, and E-glass rods of the 0.020-0.010 inch diameter range in specimens such as C in Figure 1. Interfacial shear stresses were created either by compressive or torsional loading of the resin matrix until failure occurred.

With Paraplex P-43 polyester resin, such fractures always took place cleanly at the interface, with no apparent material transfer, at a shear stress of approximately 1,000 psi., irrespective of glass finishing treatment of rod diameter. This stress clearly is much lower than the bulk cohesive, tensile, compressive, or torsional strengths of the two components. With Epon 828 epoxy resin, clean inter-facial fractures never took place; the resin pluking out large pieces of the rod, or vice versa, with gross transfers of material and at apparent shear stress values in the range of 3,000-4,000 psi. This approaches the cohesive strengths of the components, and indicates the formation of good joints that also proved independent of glass finish or diameter. Thus, the higher joint strength in conjunction with the greater ductility and perhaps the lower cure

Table 3. Average Flexural Strengths of Wet and Dry Laminates

Resin/Catalyst	Dry	Wet*	% of Dry Strength
Paraplex P-43/DDM	100,900	80,200	80
Paraplex P-43/ATC	92,200	69,500	75
Epon 828/A	100,300	88,600	89
Epon 828/CL	104,000	97,400	94

* Tested after two-hour immersion in boiling water.

Table 4. Flexural Properties of Polyester-Glass Laminates

Paraplex Resin	Flexural Strength, Psi.		Flexural Modulus, x 10^6 Psi.	
	Resin	Laminate	Laminate	Resin
P-43	17,500	64,000	3.5	0.62
P-444	17,400	68,000	3.5	0.63
P-49	13,000	62,000	3.2	0.45
P-47	10,800	47,300	2.8	0.31

Table 5. Tensile Properties of Polyester-Glass Laminates

Paraplex Resin	Tensile Strength, Psi.		Ductility,	Tensile Modulus, x 10^6 Psi.	
	Resin	Laminate	% Strain at Fracture	Laminate	Resin
P-43	9,000	46,500	1.7	3.1	0.59
P-444	10,000	43,250	1.1	2.3	0.66
P-49	7,200	43,000	1.8	2.9	0.43
P-47	6,200	38,900	3.5	2.2	0.32

shrinkage of the epoxy resin are believed to account for its superior moisture-resistance in laminates.

In the above investigation, the insensitivity of joint strength to glass-finishing treatments (heat cleaning, acetone washing, Finish 136, Finish 139) was unexpected in view of the chemical bridging action that some such finishes are thought to perform (18). Experimental data have been presented which correlate the effects of glass surface treatments on the adhesive strength of glass butt joints in tension with laminate flexural strength (19), but the recognized difficulties in this type of adhesive testing (20) render the correlation questionable.

Perhaps more likely is the hypothesis that the better finishes merely facilitate more complete penetration of the fiber bundles by the resin, with fewer voids and uncoated fibers to serve as water-transmission ducts, thereby inhibiting wet strength reductions. The properties of the dry laminate also would be enhanced because stress concentrations from voids that lower the apparent laminate strength would be reduced and more complete load distribution between resin and fibers would give greater stiffness, thus lessening injurious glass-glass contact.

The inferior properties of grossly resin-starved laminates are well known. That enhanced wetting actually is the primary contribution of superior finishes is suggested by the approximate correlation between glass finish, moisture absorption, and mechanical properties (wet and dry) of the "Source 1" P-43 laminates in the N.O.L. study (12); by the rate of wetting-glass finishes work of Soukup and Bratton (21); and by the widely-recognized relationship between laminate translucency due to more complete glass-resin contact, wet strength retention, and glass finish effectiveness (19).

Since the resin-glass joint tests of epoxy specimens in the work previously described (17) invariably showed resin and glass cohesive failures, it is difficult to believe that any finishing agent can greatly improve upon this situation. The N.O.L. epoxy laminates are clearly finish-sensitive in their mechanical properties; therefore, resin penetration and wetting probably is the true explanation—though yet to be established conclusively.

Laminate Mechanics

Because of the great difference between the elastic moduli of resin and glass, the glass fibers in certain laminates support the major share of the applied load at any level of elastic deformation. An elementary calculation (5), based on the moduli ratio and proportions components present, places this share at 94-98% for a typical high glass-content laminate (composed of parallel laminated, uni-directional, non-woven, continuous filament fabric) under a tensile load in the fiber direction. Only under these artificially ideal conditions of laminate structure and loading can the calculation be substantiated experimentally (22).

With less simple fabrics, more complex ply orientations, or with arbitrary loading directions and modes, the mechanical properties of the resin assume an importance not recognized theoretically (1) and heretofore difficult to understand experimentally. Perhaps the simplest way to illustrate this point is with a cross-

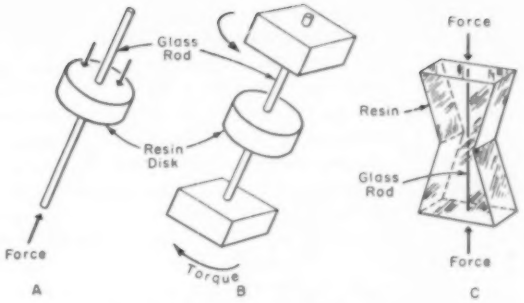

Fig. 1. Resin-glass bond specimens.

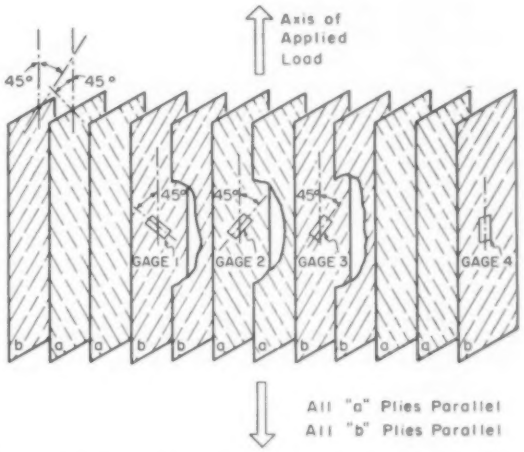

Fig. 2. Tensile specimens. Note ply lay-up and gage positions for tests.

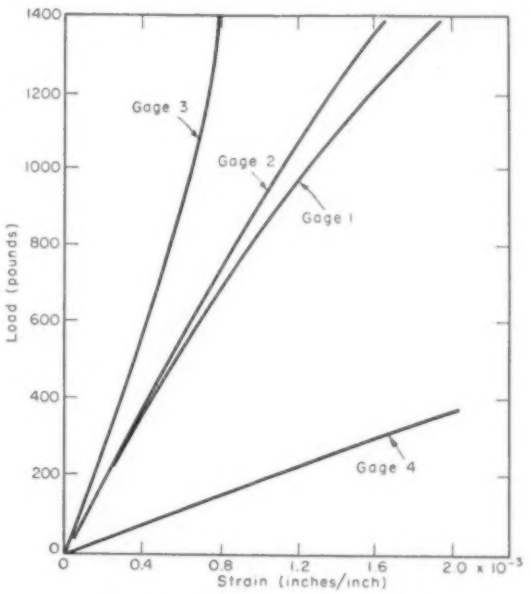

Fig. 3. Load-strain responses in tension.

laminated, uni-directional, continuous filament fabric, loaded in tension along an axis bisecting the angle between filaments in a balanced laminate.

By laminating resistance wire strain gages between parallel plies, as shown in Figure 2, the strains of adjacent, dissimilarly-oriented ply pairs can be measured, providing qualitative information about the action of the single resin layer between the two pairs of plies (23). Under tensile loading, the strain gage responses are as shown in Figure 3, revealing that the resin layer in question (between the ply pairs observed by gages 2 and 3) undergoes severe shearing deformation from the initial load application. The fibers in both ply orientations tend to rotate oppositely, aligning themselves with the loading direction. The resin is not stiff enough to prevent this; does not have a great enough cohesive strength to avoid fracture when the large shear deformation is imposed on it by the fiber action; and lacks sufficient ductility to yield without fracture as it is forced to deform. Cohesive resin failure resulted in laminate failure as was evident from the delaminated appearance of the fractured specimens.

Qualitatively similar mechanical action occurs in all fabric-based laminates, and the properties of resin cohesive strength, modulus, and ductility control laminate behavior to greater or lesser degrees, depending on the fabric used, the orientation of plies, and the direction and mode of loading. That the great difference in glass-resin adhesive strengths between epoxy and polyester is manifest only in wet-strength retention of laminate supports this hypothesis, the resin cohesive strengths being equivalent, and substantiates the friction concept (5, 17) thought to be the primary mechanism of stress transfer between glass and resin in a loaded laminate.

The disparity between glass and resin moduli has been noted. At low-load levels, this stiffness mismatch and the accompanying peeling stress concentrations that result produce glass-resin or resin-resin shear cracking adjacent to the fibers on the fine scale. The consequent reduction of stiffness when friction forces from resin cure-shrinkage substitute for structural continuity in transferring stresses causes the familiar initial and secondary modulus behavior (2, 17). Further loading produces greater resin distortion by fiber displacements, and its eventual gross cohesive failure causes laminate destruction.

The ideal laminating resin thus should exhibit tenacious adhesion to glass fibers, high modulus, high cohesive strength, low coefficient of thermal expansion, and appreciable ductility prior to fracture. If such a combination of properties in any single material appears unlikely, attention is directed to such polycrystalline materials as steel and certain aluminum alloys. If laminate stiffness is not important, the example of rubber as an adhering matrix for various organic fibers is both impressive and consistent, within the context of the foregoing remarks.

The task of specifically relating resin and laminate properties for utilitarian or design purposes is formidable, although some information recently has been published (24). It should be done soon, since more and more detailed laminate design procedures and analyses are completely neglecting the resin-reinforcement interrelationship though intended for structural designers' use (25). Perhaps an effective approach to the problem can be found in simple flexural testing, using refined methods of strain and deflection measurement (26), since this mode of loading controllably imposes known interlaminar shear stresses on the resin that directly influence the deflection of the beam specimen. The data in Table 4, based upon polyester-181 fabric laminates and intended only for general reference purposes (6), would seem to bear this out.

As the cohesive strength and modulus of the resin decline, the flexural strength and stiffness properties of the laminate also decrease. In tensile testing of these laminates, the resin cohesive strength should not be so influential because of the reduced importance of interlaminar shear stresses in such loading parallel to the principal direction of the fabric, but resin stiffness should affect laminate stiffness. This is true since the stiffer the resin, the more firmly fixed will be the fibers, a situation reflected by their greater resistance to displacement (higher laminate modulus). Finally, resin ductility effects may be evident since a more brittle resin may fracture cohesively under local deformations earlier in the load cycle, adversely affecting laminate stiffness by reducing fiber constraints.

The data in Table 5 could perhaps be so interpreted (6). In the case of the P-444 resin, apparently its greater stiffness in tension is more than offset by its reduced ductility, and the resultant laminate modulus is lower.

Conclusions

The mechanical properties of fiberglass-reinforced laminates usually are directly influenced by such resin properties as glass-resin joint strength, resin modulus, cohesive strength, ductility, coefficient of thermal expansion and, possibly, cure shrinkage. The degree of influence necessitates consideration of glass fabric construction, ply orientation, and external loading conditions. Experimental methods to measure directly or understand some of these correlations have been developed; others are suggested.

The role of glass-finishing agents is limited primarily to influencing the degree of resin penetration and wetting of the glass fibers during laminate fabrication. No specific finish-strength interaction on glass-resin joints is believed to exist.

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(Continued on page 72)

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Advances in Phenolic Materials and Processes During 1958

1958 was a challenging year for phenolics. The tremendous upswing during the last quarter of 1958 negated, to a large degree, earlier softness in the market. The year also saw a large phenolic molding compound supplier leave the field, presumably to concentrate in other areas.

Last January, Lidstone (1)* predicted that phenolic materials could be used for molded printed circuits. He also mentioned high dielectric-strength phenolics which rival alkyds; a high-impact sisal compound of good moldability; the widely-available, colored thermosets; and the combination of arc resistance, heat resistance, and strength in one material. These predictions and others either have come to pass or are under development at the present moment.

A press manufacturer has designed an automatic molding machine for transfer or plunger molding (see Fugure 1). The press is designed so that transferring is done by a bottom plunger. The powder is fed automatically into the plunger well, the press is closed, and transfer takes place. This press can be used in conjunction with some means of preheating the powder prior to loading into the transfer well. The manufacturer claims molders can keep their capital expenditures down by means of these combination presses. When transfer work tapers off, the same presses can be used for compression work. Presses are now available in capacities from 100-450 tons, with the possibility of larger tonnages in the offing.

Another press manufacturer has introduced a preheater for automatic presses known as an "integral preheater unit" (see Figure 2). This preheater combines infra-red heating of the powder in the hopper with continual agitation of the powder to prevent precuring. Initial results indicate cure reductions between 15-25% over cold-powder cures. This preheater is not intended as a substitute for more elaborate high-frequency powder preheaters, but rather as a simple and dependable method of achieving reductions in cure time at a minimum of additional capital investment.

An electronic preheater manufacturer has devised a preheater with a newly-designed electronic control that automatically adjusts for variations in moisture content, density of the pill, and room temperature to deliver uniformly-heated preforms. Two types of controls are available: one control is set to interrupt the circuit as soon as a pre-set amperage reading is obtained; and the other control is adjusted to interrupt the circuit when a pre-set amount of heat is attained in the preform. This second control employs a thermocouple imbedded in the tray of the preheater.

I have cited several examples of rather unusual work which equipment manufacturers have undertaken to enhance the value of phenolics. Of course, other manufacturers continue to improve their products so that today equipment used for the molding of phenolics is of a quality level unknown only 5-10 years ago.

The material supplier, too, has been busy improving his product and working with his customer, the molder, to secure new business. The area which he has attacked to the greatest extent is the one in which parts were fabricated formerly from metal. For example, blower wheels have been molded very successfully from phenolics(2). These wheels formerly were fabricated from metal, but phenolics have done an excellent job at a considerable cost savings. With more and more specialty materials to choose from, the molder has been able to show that many parts, formerly die cast, can

*Numbers in parentheses refer to Bibliography at end of article.

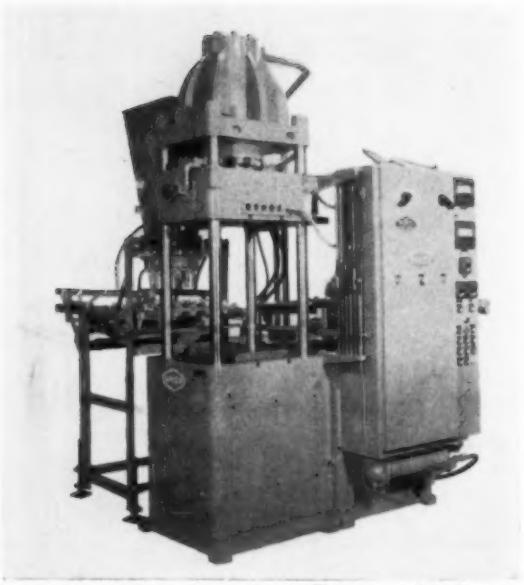

Photo courtesy: Baker Bros., Inc.

Fig. 1. Typical automatic compression and transfer press.

be molded successfully to give adequate strength with significant weight savings and, most important, cost savings.

The product which occasioned the greatest amount of phenolic-material supplier effort is sisal-filled phenolic. It has been demonstrated that sisal-filled phenolics can be molded with facility to produce parts of excellent surface luster and outstanding impact strength. These sisal-filled materials have been examined extensively throughout the automotive industry for various automotive components. They are light in weight and exceedingly strong. Sisal-filled phenolics can be used for automotive heater housings, glove compartments, gears, wheels, pulleys, electric motor end-bells, and in other applications where high strength is required.

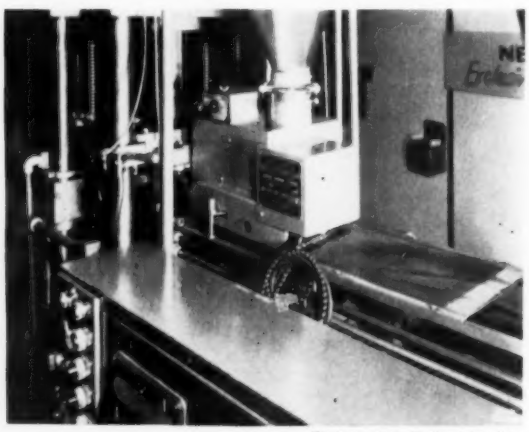

Photo courtesy: F. J. Stokes Corp.

Fig. 2. Integral preheater mounted on automatic molding press.

Phenolic-glass is another new material that received considerable impetus in 1958. The nature of the product is such that molding shrinkage is not encountered; in fact, there is a tendency toward molding expansion in the order of 0.0009 inch per inch. This has enabled molders to mold articles such as transmission gears and a ring-shaped clutch cone for automatic transmissions. The acceptance of these parts was brought about largely by utilizing the dimensional stability offered in a glass-phenolic molded part. The excellent strength offered by these materials and their ability to wear under adverse conditions also has led to their acceptance. This combination outlasts materials previously used, easily resists high transmission temperatures, remains dimensionally stable under all operating conditions, and eliminates the tendency to gall or roll-up which would cause too small clutch clearances.

Keeping pace with a color-conscious market, one supplier has developed a melamine-modified phenolic. It is claimed that the melamine contributes light-fast, permanent color and, in electrical grades, excellent arc resistance. At the same time, many fine qualities of phenolics, such as dimensional stability, impact strength, heat resistance, high electrical insulation, and low water absorption, are retained. It is further claimed that these products possess lustrous colors combined with the rugged durability of phenolics. They can be preformed and molded easily by either the compression or transfer method.

There has been considerable effort to determine the characteristics required of a thermosetting material for automatic molding(3). There is a considerable difference between requirements for automatic molding and for the more conventional semi-automatic molding process. Powder uniformity is all-important. Excellent hot strength and hot rigidity, together with rapid flow, fast cure, and excellent mold release, are the chief requirements. There also has been considerable work undertaken on the vast subject of impact testing(4). It has long been recognized that the measurement of impact strength is one of the more difficult of the significant measurements of plastic molding materials. This is particularly true in the thermosetting plastics segment of the industry, where a simple, universally-used impact test should be developed to yield the pertinent information required by end-users and designers.

Phenolics during 1958 have been used in applications which lend new glamour to the phenolics industry, particularly those dealing with uses in the missile and space vehicle field. In the space age, it is extremely interesting and gratifying to note that of the vast num-

(*Continued on page 52*)

Edited by:
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Machinery Maintenance

Quick Repair of Injection Machine Clamping Ring

RECENTLY, when I was visiting a local injection molding shop, the foreman of the plant informed the owner that it was necessary to shut down one of the machines. He had found a very bad leak in the feed cylinder cooling jacket. The main concern was the time involved before the unit would be back in production.

The maintenance operation involved removing the cylinder from the machine, and delivering it to a machine shop with equipment capable of turning down the outside diameter of the water jacket to a new gasket size. This, together with fabrication of a new clamping ring with water inlets and outlets, would be both time-consuming and expensive.

At this point, I intervened and suggested a simpler and more effective method to put this machine into working condition quickly. This idea can be best demonstrated by an example, graphically presented in the accompanying illustration (see p. 72). All figures shown are in inches.

A Reed-Prentice 10D8 injection machine would require two blocks, four by four by 7¼ inches, of mild steel or aluminum. The latter is preferable, because of its high corrosion resistance and greater conductivity.

A clearance hole is drilled in block "A" and, along the same centerline, a ½-inch bolt hole is drilled and tapped in block "B". Using these holes and a bolt of proper length, the blocks are secured to each other. Next, the 5.625-inch diameter hole is established with its horizontal centerline 2¾ inches from the top of the assembly. The joint line of the two blocks will provide the vertical centerline.

The assembly is set up in a lathe, and the 5.625-inch hole is bored, after which the blocks are removed and separated. The space required for the hopper, usually 3½ inches in width, can be made with a hack saw. A heel to assist clamping is provided by removing a ⅛- by 1-inch piece from block "B."

In the last operation, cooling lines, 7/16-inch in diameter, are drilled. These consist of two vertical passages connected by two horizontal ones. Care should be taken in locating the vertical passages in block "A", so that they do not break into the bolt hole. The openings are tapped for ¼-inch NPT; two holes in each block are plugged, while the others provide an inlet and outlet for the coolant. When mounted, this assembly will provide an efficient cooling device.

Using flare and compression fittings, the inlets and outlets may be joined with ½-inch O.D. copper or soft-steel tubing, as shown in the diagram. It should be noted that the bored hole should be within 0.005-inch tolerance to give a neat bearing surface and provide good conductivity. This is the only close tolerance required on the job.

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. . . But Never Plastics Engineering

(Cont'd. from page 43)

what prerequisites are required; and what fees are involved.

(2). Illustrated literature available to students describing the field, the materials, the opportunities, the accomplishments, etc. These booklets would be made part of the classroom or library.

(3). The encouragement of more exhibits on plastics and prizes for same in the Science Fairs. This can be accomplished at both the local and national levels. The prizes might be furnished by the local plastics industry, local SPE chapters, or nationally by SPI.

(4). To encourage more Junior Achievement sponsorship among local plastics companies in a given area, and to advise in these activities. This type of training is invaluable to our youth, and the body of business knowledge acquired is large, effective, and real. Scholarships already are available through Junior Achievement.

(5). To encourage more plastic craft and informative programs at the secondary-school level, incorporated through their existing manual training and home economics courses.

(6). To encourage plastic craft and plastic do-it-yourself programs in coordinated youth groups, such as Boy Scouts, Girl Scouts, 4-H, etc. (The effort to get the Boy Scout Merit Badge in plastics is a step in this direction.)

(7). To have locally-available films, displays, and scripts for speakers to use at school assemblies and before church and club audiences.

(8). To make available open-house tours of plastics plants within an area to stimulate interest by seeing the magic of materials at work.

(9). To provide packaged projects which can be incorporated immediately into existing curricula and in various school projects. These packaged Science Demonstrations would be short lessons on such subjects as "Identification of Plastics," "Making Plastic Foam," "Making an Encapsulation," etc.

This type of program takes plastics out of the shop and brings it to the classroom level, much the same as later college courses on plastic subjects. This type of program also can be instituted at the shop or manual-training level with such prepared kits as: "How to fix a car body with epoxies," "How to make plastics flowers," or even possibly "How to build a fiberglass-reinforced polyester boat."

The programs could be taken even a step further by preparing kits for the art classes in the uses of various plastics as art media: foam for sculpture, resin paints, thermoplastic color chips for montages, and so on.

(10). To encourage student attendance or membership in the SPE so that the student in school can get a taste of professional activity, and so that he or she can meet local representatives of the plastics industries.

(11). To encourage and provide part-time (afternoon, evening, and Saturday) jobs for secondary and high school science teachers in the plastics plants in the area in order to give them a better understanding of the industry. If plastics firms take the lead in this program, it will engender good feelings towards our industry.

(12). To encourage written articles on plastics arts and crafts in popular crafts and science magazines read by young do-it-yourselfers and persons generally interested in scientific things.

(13). To encourage educational TV programs, where available, to tell the plastics story and what it can do. These programs, in the form of panels, symposia, and actual demonstrations of materials and their uses, can complement programs already initiated in schools.

A start for this whole program, for example, might be initiated by individuals in local SPE chapters preparing the science kits described in Item 9. These local members would prepare the script and kit (a film can be borrowed or a copy made from the existing film libraries of SPI or one of the large plastics firms who have such films). Along with this would be the enlistment of active school or group interest, and acceptance of the idea. Successful attempts in this field can be exchanged among the various SPE chapters. These kits likewise could be used by individual members who have been called upon to talk about plastics before social, business, and church groups.

In summation, the program described in this editorial is an active one, but the need for students whose sights are set toward some phase of the plastics field is vital. We need students whose experience includes the practical, as well as the theoretical. We need a steady stream of trained, interested, and educated persons to fill the gaps from research men to machine operators and consultants to secretaries. Right now, we need active, lively, and constructive backing of our existing professional groups to translate these ideas into reality. Will you give your support? —THE END

Advances in Phenolic Materials and Processes During 1958

(Cont'd. from page 50)

ber of synthetic materials available, the work-horse of the industry, phenolics, has done an outstanding job. Phenolics are able to perform so outstandingly because of their ability to withstand extremely high temperatures for short periods of time. Temperatures due to the friction of a missile or space vehicle re-entering the earth's atmosphere can be as high as 25,000° F. for up to a few minutes. The molded article must act as an insulator and heat barrier to protect sensitive instruments and wiring inside the missile or space vehicle. The uniform ablation or erosion effect of phenolics also is outstanding(5).

Gruntfest and Shenker have shown that phenolics are outstanding in nose-cone work(6). They further indicate that fillers of the glass, asbestos, and quartz types in conjunction with phenolic resins are enabling this country to progress rapidly toward the day when a manned space vehicle will be a fact. Asbestos-filled phenolics(7) are being used for many internal parts in the missile itself. There will be, no doubt, many forms of phenolics used in the missiles of the future. Even at this point, many components have been fabricated from phenolics: to mention only a few, missile nose cones,

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What A Plastics Engineer Should Look For When Planning To Buy A Compression Or Transfer Press

Proper planning includes due consideration of production requirements, specific machine features, and auxiliary equipment.

THE purchase of a compression or transfer molding press and auxiliary equipment may involve a capital expenditure of $20,000 or more, depending on size and design. Since this amount of money is not likely to be found lying around in a petty-cash account, the engineer responsible for determining the type of press to be bought should consider carefully all features of the equipment available and all pertinent factors in the proposed operation in order to insure that the money is spent wisely.

Foresight is far better than hindsight in this case, and careful, detailed advance planning will do much to prevent later frustration, unhappy compromises, or expensive modifications.

General Considerations

Certain fundamental attributes are required in presses for molding thermosetting materials that are more or less independent of the type of material used or the types of molded parts produced. The following three,

broad and general requirements should be satisfied first, before deciding on more specific features of the equipment.

(1). The press to be bought should be as flexible and versatile as possible, consistent with reasonable first cost and operating needs. This is particularly true for a custom-molding operation where a variety of molds and materials will be run under differing molding conditions. Even in a captive operation, a considerable degree of flexibility in press equipment is desirable in order to accommodate future developments in part and mold designs, and in materials.

Such features as adjustable daylight, adjustable closing and pressing speeds, and adjustable hydraulic pressure, as well as ample unobstructed platen area to accommodate molds of varied size and shape and to facilitate mold setting, are very desirable. Many of these features are either available as standard equipment on modern presses or can be provided at little extra cost when the press is built.

The controls on modern compression and transfer presses, including the automatic types, are remarkably flexible and permit quick, easy changes in cycle in order to maintain efficient production under varying conditions, or to adapt to new part and mold designs.

(2). The press design should be as simple, rugged, and foolproof as possible. Presses in production molding plants are not operated by watchmakers or toolmakers and are liable to be abused. Therefore, there is no proper place in such an operation for excessively complicated, delicate mechanisms requiring frequent, careful, and time-consuming maintenance and adjustment. Breakdowns and consequent lost production are costly.

Recognizing this fact, press manufacturers, in general, have strengthened and improved their designs in recent years, and certain manufacturers have adopted J.I.C. machine tool standards* in press construction to provide further ruggedness and reliability. These features should be kept in mind when setting up performance specifications.

The press should have sufficient mechanical strength, and the associated equipment should have sufficient reserve power and hydraulic capacity to withstand 15% overloads. This is not to suggest the practice of overloading, but to assure satisfactory operation without equipment damage, if and when overloading occurs.

The press should be designed and installed for easy maintenance and lubrication, particularly of parts such as bearings and toggle joints that are subject to constant wear. Dust seals should be provided to exclude abrasive dust from major moving parts and from electrical controls such as relays, contactors, and limit switches which are vital to continuous trouble-free operation.

(3). The press should be safe, with adequate and proper protection for operators and molds. This is mandatory in an automatic operation. Fully positive, cam-actuated controls with mechanical interlocks are favored by some production men who fear malfunction of electrical and electronic controls due to poor electrical contacts, wiring faults, or voltage fluctuations.

*J.I.C. Standards are standards for design and construction of electrical, hydraulic, and pneumatic controls and components of machine tools, including hydraulic presses. They are set up by the Joint Industrial Council.

Control by positive, mechanical cam action is accomplished readily in smaller presses, and is used on a number of well-designed automatic types. It is not equally feasible in larger presses because of the weight and inertia of large moving parts. In these cases, where electrical controls are used, the "fail safe" principle should be employed. The operation should be controlled by sequence switches in such a manner that, if any step is not completed, the remainder of the cycle is interrupted and the press remains inoperative until the fault is corrected. The press then will resume automatic operation when restarted by the operator.

Production Requirements

Next in his advance planning, the engineer should studiously review with his sales, production, and development departments, the general production requirements of the operation in which the press will be used. The four following factors generally are interdependent and must be evaluated in combination, rather than singly.

Mold Size

The size of the molds to be run or (if no molds exist) the size of the parts to be produced, the anticipated requirements, and the estimated production rates will give some indication of required press size, when considered together. The probable length of production runs and frequency of mold changes must be considered, particularly in custom molding, insofar as they will reduce total press output. The mode of operation, whether automatic or semi-automatic, also will affect this decision. Where continuous, automatic operation is feasible, a smaller mold and press may well satisfy the requirements at a considerable saving.

Thermoset Material

The types of thermosetting materials that will be used are equally important factors in the choice of a molding press. Phenolics, melamines, ureas, and alkyds all can be compression molded, but their molding behaviors differ. With phenolics and melamines, a fast-closing press is advantageous in order to reduce idle cycle time and obtain maximum output with current, fast-curing formulations.

With ureas and particularly with alkyds, rapid approach and closing are practically imperative for successful operation, because of the fast cure and consequent short flow-periods of these materials. Because of these factors, urea and alkyd materials are poorly suited to transfer molding and rarely are molded by this method, particularly on large, intricate parts requiring extensive flow.

Automatic presses are now available with maximum approach speeds of 300-400 inches per minute and final closing speeds of 20-27 inches per minute. Both these characteristics are adjustable over a considerable range. Similar features can be provided on semi-automatic presses.

Relation to Other Presses

The relation of this press to any other, already-installed press equipment, as well as future additions,

should be studied. If, for good and sufficient reasons, this is to be a semi-automatic press and the first unit in a new molding operation, a self-contained press, equipped with individual motor and pumps, generally will be the proper choice. This provides flexibility both in location and in operation.

If the plant already has a number of semi-automatic presses operating on a central accumulator system which has excess capacity, some money can be saved initially (approximately $3000, in the case of a 100-ton press) by purchasing a press equipped only with necessary valves and cycle controls and connecting this to the central system. However, the disadvantages inherent in a central pressure system should be recognized. The main pumps must be operated, even if only one press on the line is in use; conversely, a breakdown of the central pumping system will idle all presses on the line, unless standby pumps, provided at added cost, are available.

An installation of self-contained presses obviously is more flexible, since any or all presses can be operated independently as needed. Largely for this reason, most of the recent semi-automatic press installations, even in plants having central accumulator systems, have been of the self-contained type. Automatic presses sold at the present time are self-contained units, in most cases.

Location and Lay-Out of Press

Finally, the location and lay-out of the proposed press should be planned to provide adequate floor space, head-room, light, and ventilation for efficient operation and maintenance. Sufficient working space around the press and aisle space should be provided to allow easy access and a smooth, uninterrupted flow of material and finished parts to and from the press.

Specific Features

Having considered the fundamental requirements of the molding operation and the basic features needed in the press equipment, the engineer now should consider specific equipment features. These will include the following six factors:

(1). Press capacity.
(2). Press type:
  a. Compression or transfer.
  b. Pressure fluid—oil, water, or air.
  c. Full fluid or toggle-fluid operated.
(3). Mode of operation:
  a. Automatic.
  b. Semi-automatic.
(4). Heating methods.
(5). Controls:
  a. Full manual valves.
  b. Manual, pneumatic, or solenoid pilot valves.
  c. Electrically-operated pilot valves.
  d. Clock-operated cycle timers.
(6). Auxiliary equipment:
  a. Preheater.
  b. Preformer.

Press Capacity

As stated previously, the press size will be determined by the size of the molds to be run and this, in turn, will depend upon the size of the parts to be produced, the desired output, and the mode of operation (whether automatic or semi-automatic).

Assuming that molds of sufficient production capacity already are in existence, the press size can be calculated readily, using empirical values of molding pressures required for the materials to be used—either obtained from previous production experience or recommended by the material and press manufacturers. The technical service representatives of these companies can assist the engineer considerably at this point, and should be consulted.

If molds must be designed for the projected operation, the engineer will need to estimate molding cycles in order to determine the mold sizes required for the desired output. Once mold sizes are fixed, the press capacity can be determined easily, as pointed out above.

Previous design and production molding experience are invaluable to the plastics engineer in this rather tricky estimation of molding cycles. Again, it would be well to work closely with material suppliers, mold builders, and press manufacturers to obtain full benefit from their practical experience and suggestions. In addition, some information is available in the plastics literature (1, 2, 3)# on methods of calculating mold capacities. During the course of this study, careful thought should be given to the possibility of automatic operation. If feasible, this may permit a definite saving in mold and press costs.

Type of Press

Even though the projected operation is planned only for compression molding, it is entirely possible that some transfer molding will be necessary at a later date. It would be wise, therefore, to provide for this eventuality by either buying an auxiliary ram transfer press that also is suitable for compression molding, or a compression press designed for quick and inexpensive conversion.

The cost of a top ram transfer press is only about $1,000 more in the case of a "bare" press and $3,000 more in the case of a self-contained unit, than that of a straight compression press of the same tonnage. Also, it is possible to purchase a self-contained compression press with a cored and bushed opening, with drilled and tapped bolt-holes in the head for a transfer ram, and with space in the power unit for later addition of the top ram pump and controls, when needed.

Although commonly and loosely called "hydraulic" presses, all modern medium and large self-contained plastic molding presses use oil, instead of water, as the pressure fluid. Oil or water is used in presses operated on central accumulator systems. The initial and make-up costs with oil are greater than with water, but corrosion problems are less and oil is a better lubricant for ram packings and moving parts. Air is used only for smaller, fast-acting presses (up to 75 tons), since maximum air pressure available in molding plants usually does not exceed 100 pounds per square inch.

The choice between a full hydraulic and a hydraulic-

#Numbers in parentheses refer to Bibliography at end of article.

toggle press will depend upon considerations of comparative first cost and the size and depth of parts to be molded. Hydraulic-toggle presses use lower fluid pressures and, hence, lower-pressure pumps to attain required molding pressures, due to the added mechanical advantage of the toggles. Therefore, they usually cost less initially than equivalent full hydraulic types.

These hydraulic-toggle presses, with their fast approach and rapid opening, have proved excellent for high production molding of small, relatively-shallow parts. However, these presses do not exert full molding pressure during final closing of the mold until the toggles are nearly fully-extended. For this reason, they generally have been found less suitable for the molding of large, deep parts than full hydraulic presses.

Mode of Operation

Automatic compression molding of small- and medium-size parts has grown rapidly in recent years, especially in new departmental molding operations, since it offers possibilities for reductions in tool and molding costs. Automatic transfer molding is in an earlier stage of commercial development, but is used in full-scale production in a number of plants, and automatic transfer presses are available commercially. Since the method is not yet widely used and the individual applications are specialized, no general comparison with other molding methods is possible.

The decision between automatic and semi-automatic molding will depend on:

(a). Design of parts to be produced; and

(b). Comparative equipment and molding costs per unit output.

Parts requiring metal inserts cannot be molded automatically if no redesign is possible, because automatic insert loaders have not been perfected as yet. On the other hand, automatic molding may be entirely feasible if the part can be redesigned to eliminate the inserts or to allow them to be staked-in after molding. Automatic molding of parts with side holes or under-cuts, requiring movable side cores or split molds, is being done successfully, but is somewhat risky unless mechanically-operated core pulls, cams, or angle pins, positively controlled by press motion, can be used to minimize possibilities of mold damage.

Careful analysis will be necessary in comparing initial costs of automatic and semi-automatic molding under the specific conditions involved. In the case of a new operation, the engineer must balance the installed costs of an automatic press and mold and, possibly, a bulk powder preheater against similar costs of preforming, preheating, and semi-automatic molding equipment for the required output. Where preformers and preheaters of sufficient capacity already are available, these items will not affect initial cost, but will appear in operating costs. Obviously, accurate data or careful estimates of molding cycles under the two operating conditions is basic in this comparison.

Production experience has shown that automatic molding, with properly-designed molds can reduce production costs. Broad generalizations as to the amount of this saving are impractical, because of differences in part and mold designs, as well as in accounting methods, plant costs, and industry practices. Each case must be studied separately. Direct press-labor costs will be reduced with automatic presses. This saving will vary with the locality and with cost accounting practices, but can be significant.

Heating Methods

This is primarily an adjunct of the molds and molding conditions, and is considered here only insofar as it affects press location and installation.

Temperature control with steam, superheated water, and oil is good, and generally considered better than with electric-resistance heating. Leaks and heat losses may cause problems with steam and superheated water, if supplied from a central boiler through long pipe-runs. For this reason, location of press equipment would be restricted, in order to obtain optimum temperature control, if these heating means are used.

Electric-resistance heating usually is more convenient to install and imposes less restriction on press location. Temperature regulation generally is less exact, unless elaborate sensing controls are used. Molds can be overheated and damaged if controls fail. If power is purchased, costs will vary with local utility rates and load factors. Costs should be compared carefully with those for other heating methods.

Controls

The hydraulic controls needed will depend on the nature and precision of the work to be done, productivity desired, and a price/performance comparison.

If maximum dimensional precision and, hence, maximum cycle uniformity are desired, or if fast cycles and high production must be obtained, automatic cycle timers (operating through pneumatic pilot or solenoid valves) are advisable. With these, optimum cycles, once set, can be maintained and accurately reproduced with little or none of the variations occurring in manual operation because of operator failures or inattention.

For molding of less-critical parts on longer cycles, manually-operated valves or pilot valves may be entirely adquate, and the added cost of automatic cycle timers and other control refinements may not be justified. These remarks obviously apply to semi-automatic presses. On automatic presses, except during set-up periods, all controls are automatic and governed by timers, cams, and sequence switches.

An adjustable control, usually cam and timer-operated, that allows the mold to be opened or "breathed" for varying intervals during and after final close, is extremely useful in both automatic and semi-automatic operation. This permits escape of volatile matter (moisture, ammonia, and/or formaldehyde) evolved during cure of phenolic, urea, and melamine compounds, and frequently will reduce cure time significantly. These adjustable breathing devices are incorporated in the control systems of many modern presses.

Auxiliary Equipment

PREHEATER. Preheating is a must for semi-automatic and automatic transfer molding of phenolics and melamines in order to reduce cure-time and the molding

(Continued on page 66)

PT's Comparative Data on Compressi

Atas Hydraulics

Company name*	Atas Hydraulics				
Model	Model 250-14	Model 250-16	Model 250-18	Model 250-20	Model 250-24
Machine action	Manual or semi-automatic				
Machine design type	Side plate type with heavy frames.				
Press capacity, tons: Compression	25; 50; 75; 100	50; 75; 100; 125	75; 100; 125; 150	100; 125; 150; 200	150; 200; 250; 300
Transfer	#	#	#	#	#
Casting area, sq. in.	196	256	324	400	576
Ram or plunger: Stroke, in.	Optional	Optional	Optional	Optional	Optional
Diameter, in.	5; 7; 8; 10	7; 8; 10; 12	8; 10; 12; 13	10; 12; 13; 16	13; 16; 18; 20
Pressure on material**, psi.	255; 510; 765; 1,020	390; 585; 780; 975	460; 610 770; 920	500; 625; 750; 1,000	520; 660; 865; 1,040
Cycles per hour***	—	—	—	—	—
Speeds, in./min.: Closing	—	—	—	—	—
Opening	—	—	—	—	—
Platens or molds: Size, max., in.	14 x 14	16 x 16	18 x 18	20 x 20	24 x 20
Number of platens	Optional	Optional	Optional	Optional	Optional
Daylight opening, max., in.	Optional	Optional	Optional	Optional	Optional
Thickness (min. to max.), in.****	Optional	Optional	Optional	Optional	Optional
Locking force, tons	—	—	—	—	—
Tie bars or rods: Diameter, in.	—	—	—	—	—
Space between, in.	—	—	—	—	—
Material heating capacity, kw.	Optional	Optional	Optional	Optional	Optional
Type of heating	Electric or steam heating.				
Motor hp.	##	##	##	##	##
Floor space, ft. (approx.)	2½ x 4	2½ x 4	3 x 5	3 x 5	3 x 6
Special features	Deflection-free presses for compression molding & laminating.				
Optional features	Optional features are built to customer's specifications. Transfer molding features, pull-back cylinders, knock-out pins, and "T"-slotted platens also are available.				

#Transfer molding features available.
##Depends on closing speed required.

Company name*	
Model	60 & 75 Ton
Machine action	Auto.
Machine design type	Top ram open
Press capacity, tons: Compression	60; 75
Transfer	Auto. 15-Ton
Casting area, sq. in.	—
Ram or plunger: Stroke, in.	13
Diameter, in.	7½; 8½
Press on material**, psi.	—
Cycles per hour**	—
Speeds, in./min.: Closing	400
Opening	400
Platens or molds: Size, Max., in.	16 x 20
Number of platens	—
Daylight opening, max., in.	29
Thickness (min. to max.), in.****	10
Locking force, tons	—
Tie bars or rods: Diameter, in.	2½
Space between, in.	—
Material heating capacity, kw.	6
Type of heating	Electric
Motor hp.	7½
Floor space, ft. (approx.)	—
Special features	Flexible feedi lower indepen in pressing st Throw-away Ejectors supp
Optional features	Hydraulic sid

Automatic Molding

Company name*	Automatic Molding
Model	Automold A50B
Machine action	Auto or Semi-auto.
Machine design type	Rod
Press capacity, tons: Compression	60
Transfer	15
Casting area, sq. in.	30 at 4,000 psi.
Ram or plunger: Stroke, in.	12
Diameter, in.	1½
Press on material**, psi.	4,000 aver.
Cycles per hour**	4 seconds (dry cycle)
Speeds, in./min.: Closing / Opening	Opening and closing of the press will dry cycle in four seconds; the transfer ram will move forward 120 in./min.

Clifton

Company name*	Clifton		
Model	Model 3A	Model 30	Model 2
Machine action	Semi-auto.	Semi-auto.	Semi-au
Machine design type	Rod	Rod	Rod
Press capacity, tons: Compression	50-300	75-200	25-150
Transfer	No transfer.		
Casting area, sq. in.	—	—	—
Ram or plunger: Stroke, in.	10-12	8-12;# 12-16##	6-10
Diameter, in.	—	10-14##	5-12
Pressure on material**, psi.	[2,500-3,000	2,000-2,600	2,500-3,0
Cycles per hour**	—	—	—
Speeds, in./min.; Closing	80-100	60-84	—
Opening	32-52	32-40	(gravit return 4½-15
Platens or molds: Size, Max., in.	16 x 16 to 36 x 36	20 x 20 to 28 x 28	16 x 16 24 x 24

#Power-return presses
##Gravity

sion & Transfer Molding Machines

Baker

	75 n	100 & 150 Ton	175-Ton	200-Ton	300-Ton	450-Ton
	o.	Auto.	Auto.	Auto.	Auto.	Auto.
	m open strain rod-type fully self- contained					
	75	100; 150	175	200	300	450
	o. on	Auto. 30-Ton	Auto. 30-Ton	Auto. 50-Ton	Auto. 75-Ton	Auto. 125-Ton
	—	—	—	—	—	—
		15	18	18	18	24
	8½	8¾; 11	12¼	13	16	24
	—	—	—	—	—	—
	—	—	—	—	—	—
	0	—	400	400	400	400
	0	400	400	400	400	400
	20	20 x 24	20 x 24	28 x 34	28 x 34	36 x 42
	—	—	—	—	—	—
	5	33	33	38	38	42
	0	12	12	14	14	14
	—	—	—	—	—	—
	½	4	4	5	5	6½
	—	—	—	—	—	—
		12	12	20	20	30
	tric	Electric	Electric	Electric	Electric	Electric
	½	10	15	15	20 (two)	20 (two)
	—	—	—	—	—	—

ble feeding & measuring Loaderboard for all mold combinations. Upper and independent hydr. ejection. Meets I.C. standards. Deceleration at any time osing stroke. Breathe at any time and for any length of time-safety device. y-away type relays. All platens T-slotted. All cycles instantly adjustable. ors supplied front to back and two options right to left.

aulic side cores available.

Company name*	Bolling		
Model	Slabside Type	4-Bolt Type	Ring Type
Machine action	Semi-auto.	Semi-auto.	Semi-auto.
Machine design type	Slabside	4-Bolt	Ring
Press capacity, tons: Compression	50-2,000	75-200	200-1,600
Transfer	Can be adapted to transfer		
Casting area, sq. in.	—	—	—
Ram or plunger: Stroke, in.	12-30	10-26	—
Diameter, in.	12-36	8-23	24
Pressure on material**, psi	2,000-2,500	2,000-3,000	—
Cycles per hour**	—	—	—
Speeds, in./min.: Closing	—	—	—
Opening	—	—	—
Platens or molds: Size, Max., in.	20 x 20 to 48 x 48	14 x 14 to 48 x 48	22 x 22 to 42 x 42
Number of platens	Single or multiple decks.		
Daylight opening, max., in.	—	—	—
Thickness (min. to max.), in.****	—	—	—
Locking force, tons	123-315, To suit requirements.	71-1,228, To suit requirements.	200-1,600, To suit requirements.
Tie bars or rods: Diameter, in.	—	—	—
Space between, in.	—	—	—
Material heating capacity, kw.	—	—	—
Type of heating	—	—	—
Motor hp.	—	—	—
Floor space, ft. (approx.)	—	—	—
Special features	Extreme accuracy, low maintenance.	Single or multiple frames.	Little or no deflection.
Optional features	Bronze-trimmed cylinder throat. Pull-back cylinders. Hydraulic lift tables.	Hydraulic lift tables available. Hydraulic pumping units available. Pull-back cylinders.	

on

Model 29	Model 5
Semi-auto.	Semi-auto.
Rod	Rod
25-150	75-400
—	—
6-10	12-22 max.
5-12	—
,500-3,000	—
—	—
—	—
(gravity return)	—
4½-15	—
16 x 16 to 24 x 24	20 x 18 to 36 x 36

Davidson-Kennedy

Company name*	Press #101	Press #102	Press #103	Press #104	Press #105	Press #106
Model	Manual, pneumatic.					
Machine action	Side-plate, 2-column.					
Machine design type						
Press capacity, tons: Compression	50	50	100	100	100	200
Transfer	(No transfer)					
Casting area, sq. in.	—	—	—	—	—	—
Ram or plunger: Stroke, in.	36 max.	36 max.	50 max.	50 max.	50 max.	55 max.
Diameter, in.	—	—	—	—	—	—
Pressure on material**, psi	—	—	—	—	—	—
Cycles per hour**	—	—	—	—	—	—
Speeds, in./min.: Closing	700 max.	700 max.	600 max.	600 max.	600 max.	600 max.
Opening	300 max.					
Platens or molds: Size, Max., in.	19 x 29	28 x 36	28 x 36	32 x 46	38 x 53	38 x 53
Number of platens	2	2	2	2	2	2
Daylight opening, max., in.	36	36	50	50	50	58
Thickness (min. to max.), in.****	—	—	—	—	—	—
Locking force, tons						

Automatic Molding (cont'd.)

Platens or molds: Size, Max., in.	6 x 14
Number of platens	One set
Daylight opening, max., in.	19
Thickness (min. to max.), in.****	1 6½ overall max.
Locking force, tons	60
Tie bars or rods: Diameter, in.	2
Space between, in.	7¾ x 18⅝
Material heating capacity, kw.	Depends on die
Type of heating	Electrical or steam
Motor hp.	(No motor)
Floor space, ft. (approx.)	2½ x 3
Special features	Pneumatic with toggle action, for either straight compression or transfer molding.
Optional features	Attachment for molding threaded parts.

Clifton (cont'd.)

Number of platens	2 or multiple	—
Daylight opening, max., in.	12–16	12–16
Thickness (mn. to max.), in.****	—	—
Locking force, tons	—	—
Tie bars or rods: Diameter, in.	5–14	8–10
Space between, in.	—	—
Material heating capacity, kw.	—	—
Type of heating	Electric or steam.	
Motor hp.	7–2½	3–7½
Floor space, ft. (approx.)	30 x 40 to 48 x 50	36 x 39 to 48 x 40
Special features	Unitrol feature. Power-return.	Easily accessible valves. Dual pumping unit. Holding-time
Optional features	Any time cycles desired.	Power-return of platens. Manual operation.

ǂPower return presses.
ǂǂGravity.

Dake

	Series 27	Series 43
Company name*		
Model		
Machine action	Semi-auto.	Semi-auto.
Machine design type	Tie rod	Tie rod
Press capacity, tons: Compression	25–600	50–300
Transfer	(no transfer)	25–75
Casting area, sq. in.	550–5,320	360–1,620
Ram or plunger: Stroke, in.	14–30	14–24 (C); 12–16 (T)
Diameter, in.	2¾–12½	2¾–9
Pressure on material**, psi.	50–2,000	50–2,000
Cycles per hour**	2–100	2–100
Speeds, in./min.; Closing	190–285	190–285
Opening	265–530	265–530
Platens or molds: Size, Max., in.	25 x 22 to 70 x 76	15 x 24 to 36 x 45
Number of platens	2	2
Daylight opening, max., in.	20–50	20–40
Thickness (min. to max.), in.****	6–20 min.	6–16 min.
Locking force, tons	25–600	50–300
Tie bars or rods: Diameter, in.	2½–10	3–7½
Space between, in.	25 x 15 to 70 x 50	15 x 15 to 36 x 25
Material heating capacity, kw.	4.5–66	4.5–66
Type of heating	Steam or electric	
Motor hp.	7½–75	10–25
Floor space, ft. (approx.)	23–91 sq. ft.	25–35 sq. ft.
Special features	Electrical controls meet J. I. C. standards.	
Optional features	Speeds, platen sizes, strokes, and other specifications to meet requirements. Steam- or electrically-heated platens.	

H-

	100 Ton	200 Ton
Company name*		
Model		
Machine action	Manual or semi-automatic.	
Machine design type	Rod	Rod
Press capacity, tons: Compression	100	200
Transfer	35ǂ	50ǂ
Casting area, sq. in.	24 x 18	30 x 24
Ram or plunger: Stroke, in.	15	15
Diameter, in.	11	16
Press on material**, psi.	—	—
Cycles per hour**	—	—
Speeds, in./min.; Closing	235	210
Opening	90	80
Platens or molds: Size, Max., in.	24 x 18	30 x 24
Number of platens	One set	One set
Daylight opening, max., in.	30	36
Thickness (min. to max.), in.****	3 min.	9 min.
Locking force, tons	100	200
Tie bars or rods: Diameter, in.	3¼	4½
Space between, in.	32¾	39½
Material heating capacity, kw.	To customer specification	
Type of heating	Steam or electric	
Motor hp.	5 (C) 7½ (T)	7½ (C) 10 (T)
Floor space, ft. (approx.)	31 sq. ft.	36 sq. ft.
Special features	Both compression & transf	
Optional features	Hot plates	

ǂApplies only to transfer

Davidson-Kennedy (cont'd.)

Tie bars or rods: Diameter, in.	—	—	—	—	—	—
Space between, in.	38	28	55	38	42	50
Material heating capacity, kw.	—	—	—	—	—	—
Type of heating	As required.					
Motor hp.	3#	3#	5#	5#	5#	10#
Floor space, ft. (approx.)	—	—	—	—	—	—
Special features	Combination pneumatic & hydraulic rigid construction. Positive control.					
Optional features	Also make larger standard units (Presses #107 and #108) with capacities from 200 to 500 tons. Presses made to customer's requirements.					

#Hp. of required air compressor.

Hull-Standard

Company name*	Model 99A	350 & 250 Series	250 Series	350 Series	450 Series	550 Series
Model	Auto. transfer	Semi-auto.	Semi-auto. compr.	Semi-auto. compr. & transfer	Auto. compr.	Auto. compr.
Machine action	Horizontal, pneumatic	Hydraulic, toggle-type	Straight-ram, Hydr.	Straight-ram, Hydr.	Hydraulic, toggle-type	Straight, ram, Hydr.
Machine design type	15	50-300	50-300	50-300	50-300	50-300
Press capacity, tons: Compression	2	19-43 (250 series)	—	12½-75	—	—
Transfer	—	—	—	—	—	—
Casting area, sq. in.	1¾#	7-10#	12-18#	18-18#	7-10#	12-18#
Ram or plunger: Stroke, in.	4.5#	5½-10½##	7-16#	7-16#	5½-10½##	7-16#
Diameter, in.	9,000 max.	—	—	—	—	—
Pressure on material**, psi.	7 secs. dry cycle)	—	—	—	11½-17½ secs. (dry cycle)	11.3-13.7 secs. (full stroke)
Cycles per hour**	—	190-322	282-364	282-364	190-322	282-364
Speeds, in./min.; Closing	—	107-322	262-324	262-324	107-322	262-324
Opening	7½ x 4½##	18 x 18¼ to 36 x 31##	18 x 18¼ to 36 x 31##	18 x 18¼ to 36 x 31##	18 x 18¼ 35 x 31##	18 x 18¼ 35 x 31##
Platens or molds: Size, Max., in.	2	2	2	2	2	2
Number of platens	4½	20¾-30	24-31	24-44	20¾-30	25-38
Daylight opening, max., in.	—	—	—	—	—	—
Thickness (min. to max.), in.****	15	50-300	87½-312	87½-312	50-300	87½-312
Locking force, tons	2¾	2⅝-4	2⅝-4¾	2⅝-4¾	2⅝-4¾	2⅝-4¾
Tie bars or rods: Diameter, in.	7½	21-40	21-39	21-39	21-40	21-39
Space between, in.	0.060	Unlimited.				
Material heating capacity, kw.	Electric	Electric, steam or oil.				
Type of heating	80 psi. air	3-7.5 (250 series) 3-10 (250 series)	3-15	5-20	307.5	3-15
Motor hp.	7 x 2	2¾ x 1½ to 4½ x 3###	2¾ x 1½ to 5½ x 3###		2¾ x 5¼ to 5½ x 9###	
Floor space, ft. (approx.)	Integral heating platens, electric heating cartridges, temperature controllers; equipped with standard mold frames; uses cold powder.	T-slotted platens; bolsters & die supports; slow-close control; exclusive quicknet controller with four timers; controls mounted on press frame for ind. positive power unit. Top and bottom ejector system. Low-pressure-hydr. Combination transfer and compression. Can be converted later to fully auto.; head bored and tapped for later addition to transfer cylinder.		Combination transfer and compression.	Low-pressure hydr. 16-station Universal Hopper Feeder, all electric drive for loading board and T.O. combination.	
Special features	Controls arranged for semi-auto. molding with inserts. Auto-high-frequency preheating.	Hydraulic ejector system. Upward-acting transfer ram.		Upward-acting transfer ram.		Automatic high frequency preheating.
Optional features	#Clamping ram. ##Including mold frame. ###Press only.					

H-P-M

	300 Ton	500 Ton
Ton		
omatic.		
Rod	Rod	Rod
00	300	500
50#	80#	125#
x 24	36 x 30	42 x 36
15	18	26
16	19½	25
—	—	—
—	—	—
10	204	315
80	100	104
x 24	36 x 30	42 x 36
e set	One set	One set
36	54	54
min.	12 min.	12 min.
200	300	500
4½	5¼	6½
9½	44¾	51
cation		
¾ (C)	15 (C)	25 (C)
(T)	20 (T)	45 (T)
sq. ft.	53 sq. ft.	58 sq. ft.
t transfer models available.		

	3 decks 2-3½	Multiple
-16	—	—
—	—	—
—	—	—
10	—	—
—	—	—
—	—	—
7½	2-5	—
39 to x 40	20 x 30 to 36 x 36	—

	Water-cooled; thermostat-controlled electric heating to 450°.	Heavy-duty for lamination of sheets.
r acces-ralves. pump-unit.		
g-time to 30 mins.		
ver-rn of ems. nual ation.	—	Electric or steam heated platens. Number of decks to meet requirements.

transfer models.

Elmes

Company name*	Elmes					
Model	7100	7200	7300	7500	8624	7703
Machine action	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.
Machine design type	4-column	4-column	4-column	4-column	4-column	4-column
Press capacity, tons: Compression	100	200	300	500	750	1,000
Transfer	25	50	75	125	200	250
Casting area, sq. in.	Approx. 65 (C), 10 (T)	Approx. 135 (C), 20 (T)	Approx. 200 (C), 25 (T)	Approx. 330 (C), 33 (T)	Approx. 500 (C), 53 (T)	Approx. 650 (C), 70 (T)
Ram or plunger: Stroke, in.	12 (C); 12 (T)	15 (C); 13 (T)	18 (C); 14 (T)	24 (C); 16 (T)	30 (C); 18 (T)	36 (C); 20 (T)
Diameter, in.	2½ (C)	3½	4	5	6	7
Pressure on material**, psi	10,000	10,000	12,000	15,000	15,000	14,000
Cycles per hour**	120	120	120	100	90	90
Speeds, in./min.; Closing	285	310	300	310	275	265
Opening	245	240	185	165	165	200
Platens or molds: Size, Max., in.	24 x 20	30 x 26	36 x 30	42 x 36	66 x 42	72 x 50
Number of platens	One set	One set	One set	One set	One set	One set
Daylight opening, max., in.	24	36	44	54	60	72
Thickness (min. to max.), in.****	—	—	—	—	—	—
Locking force, tons	100	200	300	500	750	1,000
Tie bars or rods: Diameter, in.	1½	4½	5½	7	8	9
Space between, in.	29 x 10½	28x14	41 x 15½	48 x 24	72 x 36	80 x 30
Material heating capacity, kw	—	—	—	—	—	—
Type of heating	—	—	—	—	—	—
Motor hp	7½	15	20	25	30	30
Floor space, ft. (approx.)	5½ x 3½	6 x 3½	7½ x 5	10½ x 6	13 x 7½	15 x 8
Special features	Straight compression or with —T model number suffix, are compression-transfer presses. Side plate-type and housing-type units can be supplied to customers' specifications, as can press speeds, daylight openings, and die openings. All presses are electric pushbutton-operated and have electric timer-controlled cure periods. This timer can be set to start pre-heat at any time during cycle.					
Optional features	Fully automatic units can be furnished.					

Company name*

Model

Machine action

Machine design type

Press capacity, tons: Compression

Transfer

Casting area, sq. in.

Ram or plunger: Stroke, in.

Diameter, in.

Pressure on material**, psi

Cycles per hour**

Speeds, in./min.; Closing

Opening

Platens or molds: Size, Max., in

Number of platens

Daylight opening, max., in.

Thickness (min. to max.), in.****

Locking force, tons

Tie bars or rods: Diameter, in.

Space between, in.

Material heating capacity, kw

Type of heating

Motor hp

Floor space, ft. (approx.)

Special features

Optional features

Watson-Stillman

Company name*	Watson-Stillman					
Model	9382-C 9382-T	9379-C 9379-T	9383-C 9383-T	9384-C 9384-T	9654-T	10028-T
Machine action	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.
Machine design type	Four-column, open type.				Side-plate	Side-plate.
Press capacity, tons: Compression	50	100	200	300	100	200
Transfer	12½ (T)	25 (T)	50 (T)	75 (T)	25	45
Casting area, sq. in.	#	#	#	#	#	#
Ram or plunger: Stroke, in.	12 (C) 9 (T)	30 (C) 12 (T)	15 (C) 12 (T)	18 (C) 14 (T)	14 (C) 5 (T)	18 (C) 6 (T)
Diameter, in.	7 x 7½	11 x 10¼	15 x 14¼	18 x 6¼	16 x 15 (C) 11 x 10 (T)	16 x 15¾ (C) 8 x 7¾ (T)
Pressure on material**, psi	2,300##	2,200##	2,300#	##2,350##	—	—
Cycles per hour**	—	—	—	—	—	—
Speeds, in./min.; Closing	220 335 (T)	260 320 (T)	230 208 (T)	230 144 (T)	260 43 (T)	250 45 (T)
Opening	220 127 (T)	220 158 (T)	230 138 (T)	230 100 (T)	185 75 (T)	190 92 (T)
Platens or molds: Size, Max., in.	16 x 16###	20 x 21###	30 x 24####	33½ x 27###	22 x 21###	30 x 24###
Number of platens	3	3	3	3	3	3
Daylight opening, max., in.	25####	58####	32####	38####	34####	38####
Thickness (min. to max.), in.****	—	—	—	—	—	—
Locking force, tons	50	100	200	300	100	200

Company name*

Model

Machine action

Machine design type

Press capacity, tons: Compression

Transfer

Casting area, sq. in.

Ram or plunger: Stroke, in.

Diameter, in

Pressure on material**, psi

Cycles per hour***

Speeds, in./min.: Closing

Opening

Platens or molds: Size, max., i

Number of platens

Daylight opening, max., in.

Thickness (min. to max.), in

Locking force, tons

Tie bars or rods: Diameter, in

Space between, in.

Material heating capacity, kw

Type of heating

Motor hp

Pasadena

Model	Model PW	Q230 Type	B230 Type	B240 Type	H8 Type	K10-360 Model
	Manual	Manual	Manual	Manual	Semi-auto.	Semi-auto.
	Bench model	Bench model	Bench model	Floor model	Floor model	Floor model
	20	30	50	50	70	125
	118	156	156	231	342	600
	—	—	—	—	—	—
	4	4	6	6	8	10
	4	5	5¾	5¾	6¾	9
	338 lbs.	384 lbs.	641 lbs.	433 lbs.	410 lbs.	616 lbs.
	—	—	—	—	—	—
	—	—	—	—	—	—
	—	—	—	—	—	—
, in	12½ x 9	12½ x 12½	12½ x 18½	12½ x 12½	18½ x 18½	24½ x 24½
	2-3	2-3	2-6	2-3	2-4	2-4
in.	4	4	6	6	12	15
, in.****	—	—	—	—	—	—
	20	30	50	50	70	125
n	13#	13#	13#	19#	19#	26#
	—	—	—	—	—	—
w	3	4	4	6	8	12
	Steam or electric		Electric	Electric	Electric	Electric
	—	—	—	—	1½	3
	1 x 1⅞	1 x 1⅞	1⅜ x 1⅞	1¾ x 2⅛ (without stand)	2⅛ x 2⅛	—

2-stage pump that can be converted to semi-automatic operation. →

Can be adapted to another four inches in daylight. → Can be adapted for four inches more daylight. | Can be adapted for four inches more daylight.

Modifications to suit customers' requirements. →

#Slab sides.

Logan

Company name*	
Model	Compression & Transfer Presses
Machine action	Semi-auto.
Machine design type	Rod
Press capacity, tons: Compression	10-300
Transfer	10-60
Casting area, sq. in.	100-1080
Ram or plunger: Stroke, in.	6-18 (C); 8-14 (T)
Diameter, in.	4-20 (C); 4-9 (T)
Pressure on material**, psi	100-18,000**
Cycles per hour**	***
Speeds, in./min.: Closing	450-6
Opening	8-400
Platens or molds: Size, Max., in.	9 x 9 to 30 x 36
Number of platens	2
Daylight opening, max., in.	9-42
Thickness (min. to max.), in.****	****
Locking forces, tons	10-300
Tie bars or rods: Diameter, in.	1¼"-6"
Space between, in.	10-44
Material heating capacity, kw	Variable
Type of heating	Steam/ Electric
Motor hp	3-25
Floor space, ft. (approx.)	20 sq. ft. to 57 sq. ft.
Special features	Std. units include all hydraulic & control equipment.
Optional features	Can be converted to auto. operation by means of attachments. Day-lights, speeds, & controls to customers' needs.

Stokes

Model	Model 800	Model 741	Model 741T	Model 726	Model 727
	Auto. comp.	Auto. comp.	Auto. transfer	Semi-auto. comp.	Semi-auto. top transfer
	Tie rod	Tie rod	Tie rod	Tie rod	Tie rod
	15#	50##	150###	100#####	200######
	—	—	30	—	40
	—	—	—	—	—
e, in.	5	12	14 (C) 10 (T)	12	15 (C) 15 (T)
eter, in.	—	—	—	—	—
psi	—	—	—	—	—
	720	420	360	—	—
ng	—	300-400	—	230-312	230-312
ing	—	300-400	—	—	—
max., in.	10 x 6	15 x 13	24 x 20	24 x 20	30 x 24
	2	2	2	3	2
ax., in.	18¾	28	32	28	35
ax.), in.****	—	—	—	—	—
ter, in.	1¾	2½	3½	5	4
	14¾ x 5¼	19 x 14½	28 x 14½	20½ x 10½	36 x 12
ity, kw	—	—	—	—	—
	—	—	—	—	—
	2	5	15	5	15

Lodge & Shipley

Company name*	
Model	Columbia Hydr. Comp. Presses
Machine action	Semi-auto.
Machine design type	Rod
Press capacity, tons: Compression	20-75 tons /ram
Transfer	—
Casting area, sq. in.	—
Ram or plunger: Stroke, in.	16 std.
Diameter, in.	8-18
Pressure on material**, psi	432-460
Cycles per hour**	—
Speeds, in./min.: Closing	—
Opening	—
Platens or molds: Size, Max., in.	—
Number of platens	As required
Daylight opening, max., in.	16 std.
Thickness (min. to max.), in.****	—
Locking force, tons	—

Watson-Stillman (cont'd.)

Tie bars or rods: Diameter, in.	2¼	3	4¼	5¼	—	—
Space between, in.	—	—	—	—	—	—
Material heating capacity, kw	None	None	None	None	None	None
Type of heating	None	None	None	None	None	None
Motor hp	3	5	10	10	7½	15
Floor space, ft. (approx.)	3½ x 4½	4½ x 4½	4¹½ x 5½	6½ x 5½	3½ x 3½	5½ x 4
Special features	(C) Top and bottom knock-outs; fast closing and opening of dies, with automatic slow-down just prior to contact; individual-type timers; inching valve for die-setting. Presses 500-tons or larger have hi-and low-pressure pressing speeds; hydraulic stripping cylinders——→					
	(T) Double-acting ram; selective control for either compression or transfer molding; high degree of cycle control; hydraulic stripping cylinders; Models 9654 and 10026 are inverted transfer presses.——→					
Optional features	(C) De-gasing feature; adjustable opening spacers; Bolsters and parallel plates; adjustable opening in two four-inch steps.——→					
	(T) Top bolster for compression molding; de-gasing feature.——→					

#Depends on material to be molded.
##Operating pressure for machine.
###Die space.
####Opening between platens.

Lake Erie

	Compression Presses	Transfer Presses: Opposed Ram	Transfer Presses: Up-Stroke Type	Transfer Presses: Multiple-Press
Company name*				
Model				
Machine action	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.
Machine design type	Rod	Rod	Rod	Rod.
Press capacity, tons: Compression	50-2,000	100-500	200; 300	20-75 tons/ram
Transfer	—	35-160	50; 75	—
Casting area, sq. in.	—	—	—	—
Ram or plunger: Stroke, in.	10-36	12-24	14	9-18
Diameter, in.	—	—	—	—
Pressure on material**, psi	—	—	—	—
Cycles per hour**	—	—	—	—
Speeds, in./min.; Closing	—	—	—	—
Opening	—	—	—	—
Platens or molds: Size, Max., in.	15 x 15 to 72 x 48	24 x 18 to 42 x 36	30 x 24; 36 x 30	12 x 12 to 24 x 16
Number of platens	—	—	—	—
Daylight opening, max., in.	18-60	18-30	20	20-30
Thickness (min. to max.), in.****	—	—	—	—
Locking force, tons	—	—	—	—
Tie bars or rods: Diameter, in.	—	—	—	—
Space between, in.	—	—	—	—
Material heating capacity, kw	—	—	—	—
Type of heating	—	—	—	—
Motor hp	—	—	—	—
Floor space, ft. (approx.)	—	—	—	—
Special features	—	Self-contained with automatic timer, stripper reset & limit swtches.——→		Multiple, self-contained units with grids & stripperts for semi-auto.or with sham plates (with steam plates, stroke is 20-30 inches). Each unit individually operable.

Floor space, ft. (approx.)

Special features

Otiorestues

Company name*

Model

Machine action

Machine design type

Press capacity, tons: Compression

Transfer

Casting area, sq. in.

Ram or plunger: Stroke, in.

Diameter, in.

Pressure on material**, psi

Cycles per hour**

Speeds, in./min.; Closing

Opening

Platens or molds: Size, Max., in.

Number of platens

Daylight opening, max., in.

Thickness (min. to max.), in.**

Locking force, tons

Tie bars or rods: Diameter, in.

Space between, in.

Material heating capacity, kw.

Type of heating

Motor hp.

Floor space, ft. (approx.)

Special features

Optional features

Stokes (cont'd.)

	2 x 5	4 x 10	4 x 10½	4 x 2 press, 3 x 5 power unit	4 x 2 press, 3 x 5 power unit
	Positive ejection top or bottom. Preset-loading boards. Air-toggle operation. Provision for electrically heated molds, including thermostats. Positive sequence control. Double-shot protection.	Positive ejection top or bottom. Preset loading boards. Full hydraulic operation. J.I.C. electrical & hydraulic circuits. Provision for mold breathe. Double shot protection. Positive sequence control.	Positive ejection top or bottom. Preset loading boards. Full hydraulic operation. J.I.C. electrical & hydraulic circuits. Provision for mold breathe. Double shot protection. Positive sequence control. Opera-compression press also.	Automatic cycle controller allowing preselection of infinite number of different cycles. Three speed controlled closing. Convertibility to top transfer molding as field modification. Mechanical top and bottom ejectors.	Automatic cycle controller allowing preselection of infinite number of different cycles. Three speed controlled closing. Independent hydraulic circuits clamp and transfer. Mechanical top and bottom ejectors.
	Breathe attachment.	Low-pressure closing. Powder preheating. Polyester rope feed. Automatic unscrewing. Side-draw attachment.	Low-pressure closing. Powder or preform preheating. Side-draw attachment.	Low-pressure closing. Provision for electrically heating molds. Hydraulic ejectors. Heating platens. Provisions for heating and chilling molds.	Low-pressure closing. Provision for electrically heating molds. Hydraulic ejectors. Heating platens. Provisions for heating and chilling molds. Available as bottom transfer also in all capacities.

#Also available in 25-ton capacity.
##Also available in capacities of 75, 125, 150, and 200-tons.
###Also available in capacities of 50, 75, 125, and 200-tons.
####Also available in capacities of 50, 200, and 300-tons.
#####Also available in capacities of 80, 100, and 300-tons.

Williams-White

50-Ton Press	100-Ton Press	150-Ton Press	200-Ton Press	300-Ton Press	500-Ton Press
Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.
Rod	Rod	Rod	Rod	Rod	Rod
50	100	150	200	300	500
12½	25	35	50	75	125
#	#	#	#	#	#
12	12	12	15	18	24
##	##	##	##	##	##
#	#	#	#	#	#
—	—	—	—	—	—
300 approx.	300 approx.	300 approx.	300 approx.	300 approx.	300 approx.
200 approx.	200 approx.	200 approx.	200 approx.	200 approx.	200 approx.
18 x 18	24 x 20	24 x 24	30 x 24	36 x 30	42 x 36
2	2	2	2	2	2
24	30	32	36	44	54
—	—	—	—	—	—
50	100	150	200	300	500
2¾	3¾	4	4½	5	6½
21 x 8½	29 x 10½	29½ x 12	36½ x 11½	42½ x 16½	48½ x 18½
—	—	—	—	—	—
Steam or electric.					
5	10	15	20	25	35
7 x 5	8 x 5½	8½ x 5½	9 x 6	9½ x 6½	10½ x 8

Presses above are only representative of the firm's range of manufacture; special presses, both lab. and production models, can be built to order.

#Depends on material being loaded.
##Depends on hydraulic working pressure

Lodge & Shipley (cont'd.)

Tie bars or rods: Diameter, in.	As needed
Space between, in.	—
Material heating capacity, kw	—
Type of heating	Electric (to 550°F); Steam (to 400° F.)
Motor hp.	5 min.
Floor space, ft. (approx.)	—
Special features	Hollow ram construction; welded cylinder connections; replaceable packing; automatic air-bleed valve.
Optional features	Ram stroke to order; Down- or up-stroke operation; press speeds to order; pull-backs; platen size & no. to order.

Wabash

Company name*	
Model	Laboratory Presses
Machine action	Manual, Semi-auto.
Machine design type	Column type
Press capacity, tons: Compression	3,12,20,50
Transfer	20
Casting area, sq. in.	—
Ram or plunger: Stroke, in.	6-7
Diameter, in.	1¼-3¼
Press on material**, psi	800
Cycles per hour**	—
Speeds, in./min.: Closing	4 per second
Opening	Gravity
Platens or molds: Size, Max., in.	8½ x 8 to 18 x 24
Number of platens	2-3
Daylight opening, max., in.	15 std.
Thickness (min. to max.), in.****	0-12
Locking force, tons	50
Tie bars or rods: Diameter, in.	1¾
Space between, in.	—
Material heating capacity, kw	9 max.
Type of heating	Electric or steam
Motor hp.	¾
Floor space, ft. (approx.)	2½ x 2½ 30 x 30
Special features	Lab. or pilot-plant models. 20% overload capacity on rams; replaceable heaters. Exceptional good heaters. Control of pressures. Hard-chrome plated rods.

Lake Erie (cont'd.)

Optional features	Self-contained or accumulator types. Controls standard or special types to order.	—	—	—

Wabash (cont'd.)

Optional features	3-12 ton presses available with thermostatic controls on one or two platens; 30 – 50 ton presses have individual thermostat-controlled platens.

M & N

	Compression Presses	Transfer Presses
Machine action	Manual & Semi-auto.	Semi-auto.
Machine design type	Rod	Rod
Press capacity, tons: Compression	25–300	—
Transfer	—	25–100
Casting area, sq. in.	—	—
Ram or plunger: Stroke, in.	8–12	—
Diameter, in.	6–16	6–10 (C); 10–12 (T)
Pressure on material**, psi	2,500–3,000	—
Cycles per hour**	—	—
Speeds, in./min.: Closing	22–60	—
Opening	80–120	—
Platens or molds: Size, Max., in	12 x 12 to 14 x 30	—
Number of platens	2	2
Daylight opening, max., in.	8–30 min.	22
Thickness (min. to max.), in.****	—	—
Locking force, tons	—	—
Tie bars or rods: Diameter, in.	4¼–14	—
Space between, in.	—	—
Material heating capacity, kw	—	—
Type of heating	Electric or steam heated platens.	
Motor hp.	3–7½	7½–10
Floor space, ft. (approx.)	30 x 48 to 48 x 56	12 x 12 to 20 x 30
Special features	Adj. head & power ram return; adj. daylight.	Push-button controls & timer. Independent pressure control of both rams.
Optional features	Gravity return platens; pressure regulator; motor shut-off for long cycles. Speeds as required.	Pressure speeds & timer duration to customers' specifications.

*Complete company names and addresses are as follows:
Atlas Hydraulics, Inc., 3576 Ruth St., Philadelphia 34, Pa.
Automatic Molding Machine Co., 2231 S. Butler Ave., W. Los Angeles 64, Calif.
Baker Brothers, Inc., 1000 Post St., Toledo, Ohio
Stewart Bolling & Co., Inc., 3190 E. 65th St., Cleveland 27, Ohio
Clifton Hydraulic Press Co., 287–293 Allwood Rd., Clifton, N. J.
Dake Corp., Grand Haven, Mich.
Davidson-Kennedy Co., 1090 Jefferson St., N.W., Atlanta, Ga.
Elmes Engineering Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hull-Standard Corp., Hatboro, Pa.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., Buffalo 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Logan Hydraulics, Inc., 4901 W. Lawrence Ave., Chicago 30, Ill.
M & N Hydraulic Press Co., 726 Route 3, Clifton, N. J.
Pasadena Hydraulics, Inc., 1433 Lidcombe, El Monte, Calif.
F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.
Wabash Metal Products Co., Inc., 1569 Morris St., Wabash, Ind.
Watsin-Stillman Press Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Williams-White & Co., Moline, Ill.

**In compression molding, is a function of mold size and shape; in transfer molding, is related to diameter of the transfer plunger.
***Depends mainly on cure time of material used, and configuration of piece being molded.
****Depends on daylight openings.

Custom-Made To Order

ADAMSON UNITED CO.
730 Carroll St., Akron 4, Ohio
—All types of presses (automatic, semi-auto., and manual) built to customers' specifications. Compression and transfer presses built in sizes from 50-tons up and working areas from 12 x 12-inches up, with ram sizes and stokes, working pressures, and press controls to customers' requirements. Design types include rod, side plate, window-frame, barrel, and special types.

CUSTOM MACHINE & DESIGN, INC.
P. O. Box 1064, Akron, Ohio
—Multiframe presses are built to meet customers' requirements—semi-auto. or automatic to any capacity, ram diameter and stroke, and platen size or opening desired.

DUNNING & BOSCHERT PRESS CO., INC.
329 W. Water St., Syracuse, N. Y.
—Semi-auto. presses, 75–300 tons in capacity. Motor hp., molding cycle speeds, heating capacity, and floor space to meet requirements. Single or multiple platens optional.

ERIE ENGINE & MANUFACTURING CO.
953 E. 12th St., Erie, Pa.
—Compression, transfer, laminating, up-acting & down-acting presses available in all standard sizes and design styles to meet customers' requirements. Manual and semi-auto. types. Can be equipped with pull-back or push-back cylinders.

ERIE FOUNDRY CO.
Erie 6, Pa.
—Compression & transfer molding presses built to order.

FRENCH OIL MILL MACHINERY CO.
Piqua, Ohio
—Semi-auto. and manually-operated compression and transfer molding presses are made in both rod-type and side-plate designs in capacities from 30–2,000 tons, either self-contained or accumulator-operated.

HULL-STANDARD CORP.
Hatboro, Pa.
—In addition to tabulated model, also engineers and fabricates special hydraulic and pneumatic molding presses in sizes from 10–500 tons, including modern laboratory units, laminating and low-pressure presses, closure presses, etc. A "D" series covers a range of integral, self-contained, semi-auto. presses with console-style controls.

KNUTH ENGINEERING CO.
2617 N. St. Louis Ave., Chicago 47, Ill.
—Makes two models of manually-operated table-top presses for lab. or pilot-plant use.

PASADENA HYDRAULICS, INC.
1433 Lidcombe, El Monte, Calif.
—In addition to tabulated presses, also make 300-ton double-acting lab. compression presses (floor models), and a series of custom-made transfer presses from 20–50 ton ram forces.

R. D. WOOD CO.
1072 Public Ledger Bldg., Independence Square, Phila. 5, Pa.
—Manufactures special compression and transfer molding presses to order.

(Cont'd. from page 56)

pressure required. It also is very useful, for the same purpose, in the semi-automatic and automatic compression molding of these materials. The beneficial effect of preheating is not as apparent in automatic or semi-automatic molding of ureas because of their greater reactivity, although it is used. Alkyds, which are even faster-curing, are not preheated.

Electronic preheating is generally preferred in the industry, but oven and infra-red methods also are used effectively in individual cases.

PREFORMER. Probably 80% of thermosetting materials used in semi-automatic molding are preformed to facilitate handling or to permit effective preheating, or both. Automatic compression molding, on the other hand, is usually done with loose powder, except for certain special cases where spherical pills are used. Preforms also are required for two of the automatic-type transfer presses now offered commercially.

Two principal types of preforming machines are used. The rotary type, with preform dies arranged in circular die blocks, is most useful in producing large quantities of pills of given sizes and shapes. Where preforms to be used frequently will vary in size and shape, necessitating frequent die changes, a single punch (reciprocating-type) with single- or multiple-cavity dies, is advisable.

Conclusions

The engineer facing the problem of buying a compression or transfer press should study all these factors, weighing carefully the costs and the expected performance. He should take the utmost advantage of all available information from press manufacturers, material suppliers, and mold builders to supplement his own experience and ensure that the equipment purchased will be suitable, efficient, and economical.

Plenty of time and thought should be given to the decision, for he and his management will have to live with the results for some time to come.

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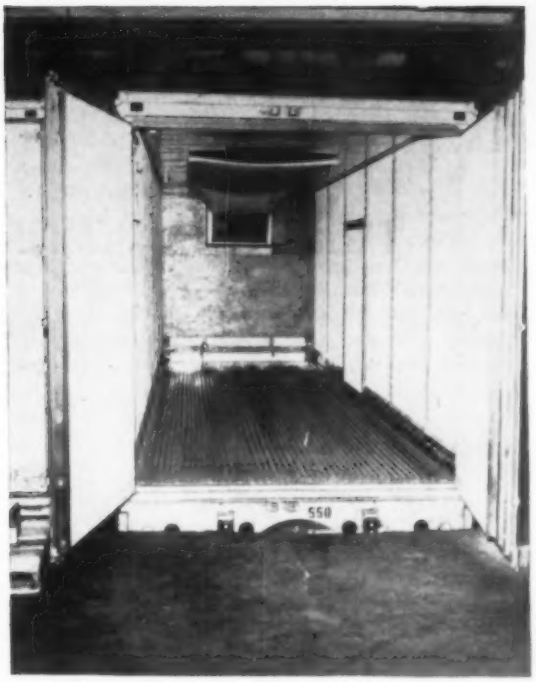
(2). "Plastics Mold Engineering," H. DuBois & W. Pribble. Published by American Technical Society, Chicago, Ill. (1946).
(3). "SPI Plastics Engineering Handbook," Second Edition. Published by The Society of the Plastics Industry, Inc., New York, N. Y. (1954).

—THE END



Urethane foam-insulated trailer truck.

Lockfoam Trailer Insulation

A large West Coast trucking company, Merrifield Trucking of Anaheim, Calif., has switched from fiberglass and foamed styrene to urethane foam insulation in its trucks which carry frozen foods. The former materials performed adequately at the freezing point, but proved ineffective in maintaining the temperature at 0° F., on long hauls.

Fiberglass batts absorbed moisture, thus contributing to rusting of the truck body, and permitted air leaks. Moisture also added to the weight, thereby reducing the permissible payload. Styrene foam absorbed no moisture, but chafed at the sides and corners. In time, this produced uninsulated spaces which leaked heat.

Lockfoam, a polyurethane foam produced by Nopco Chemical Co., proved the ideal solution, according to Merrifield reports. Double walls, formed by the aluminum truck siding and a thin plastic sheet placed four inches away, are insulated with the foam. The proper proportions of base materials are metered into this space by the Nopcometer, and the foam expands to fill the cavities. It bonds together at ceiling and floor, becoming one solid wall of insulation. There are no joints to leak.

The time required to insulate a truck is four hours for four men, as opposed to one and one-half days for the four men with the other two insulating materials. Weighing but two pounds per cubic foot, Lockfoam allows greater payloads. In addition, its increased effectiveness permits the use of lighter refrigeration units —an estimated 20% saving in cooling unit operation. Merrifield currently has 10 Lockfoam-insulated trucks, and plans to install this insulation with each addition or replacement to the fleet. —THE END

Advances in Phenolic Materials and Processes During 1958

(Continued from page 52)

blast tubes, combustion chamber liners, exit cones, flame deflectors, insert bulkhead liners, jetevator jet vanes cases, rupture disks, and nozzles. Missiles require entirely new design concepts, and the phenolic industry will keep pace with this new and fascinating field of application.

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—THE END

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

Compression and Transfer . . .

. . . molders cannot be looked upon today as being strictly custom molders. Now, they mold their own proprietary items and retain custom molding for industry, as a side operation.

All of this is integrated in new corporate set-ups, streamlined so that their business is not entirely dependent on the fluctuations common to a straight custom molding operation.

The present custom shop has operations ranging from hand-loaded molds with measured and weighed molding powder to fast, vertical, and rotary automatics with pneumatically-loaded hoppers. Many of these same custom molders also have injection molding departments, and some have departments specializing in casting such resins as epoxies, alkyds, polyurethanes, etc.

The custom molder who specializes in compression and transfer molding has amassed a wealth of know-how that accounts for many of the innovations marketed today. Outstanding among these are the inlaid melamine ware, and items containing silver and other metallic inserts used in the electronics field.

Photo courtesy: General Electric Taunton Works

Operator loading removable wedge into mold. Wedge preparation and loading is one of many details necessary in successful production of precision moldings.

Double-decker and triple-decker molds are set up in presses operating with automatic cycle timers. In the case of a triple-decker mold in which an inlaid pattern is to be formed, the production rates compare very favorably to those afforded by the automatics. Furthermore, no standard automatic press exists that will also inlay a pattern into the molded product.

Today's custom molder also achieves the high dimensional accuracy demanded in the molded parts by industry. Many of the ultra-fine tolerances requested by the instrument and electronic parts designers are accomplished in transfer molding operations, termed by the operators "Precision Molding."

Of the many custom shops now operating, one, the General Electric Taunton Works has had repeated success with parts requiring the precision molding technique. This company started its operation in 1956. Increased production in 1958 resulted in enlargement of the operation which, in turn, caused them to provide additional molding and finishing facilities. Quality-control procedures based on MIL-STD-105A are adhered to in this operation. Another part being handled by compression molding in the Taunton shops is a missile nose cone that, at this writing, is still under wraps.

•

Plastic Reodorants . . .

. . . or odor-modifiers included in resin formulations are used either to mask offensive and unpleasant odors or to enhance the acceptability of otherwise odorless products. Inexpensive aromatic compounds for industrial applications tend to increase the number of uses to which a basic plastic compound can be put. In many industrial applications, such as electronic components and housings, a slightly unpleasant odor may be accepted or otherwise go unnoticed. But where a finished item comes into close contact with the consumer, or where the possibility exists of offensive odors accumulating in closed areas (such as in a bathroom, closet, or interior of an automobile), the scent might reduce the desirability of a particular plastic product.

Photos courtesy: Sindar Corp.

Kettles and condensing columns producing various scented materials. (Left)

Research laboratory set-up. (Right)

Odor in plastic products occurs in some cases from the basic resin itself or from any of the many additives such as stabilizers, anti-oxidants, plasticizers, etc., added to it in the course of manufacture. Over the years, resin manufacturers have had as a primary objective the deodorization of their materials. In this they have made great strides, and today's materials, in fact, are reduced to a low odor level.

All this has made possible the subtle use of reodorants to apply a pleasing fragrance whose connotation is such that a woman, for example, associates it with familiar products intimately used in her everyday life. Other odor additives lend authenticity to a vinyl that simulates leather in look and feel, and now also may have the odor of tanned hides.

In order to explain the mechanics of odor-producing materials, the pertinent properties of vanillin which would justify its consideration as a raw material in plastic odorants will be explained. At the same time, it will also explain why the natural vanillin is no longer widely used.

The biggest single factor in its favor is that it is a crystalline material which would lend itself to dry mixing when used alone. When formulated, it takes on the consistency of an oily liquid. It exhibits a boiling point of 285° C. in CO_2. This would mean that it could withstand the temperatures associated with calendering or curing plastics.

The formulated mixture of vanillin, because of its high residual odor, possesses a shelf life of many months when added to a plastic film. This is possibly due to its low vapor pressure of four mm. Hg. at 146° C., which is less than 0.01 mm. Hg. at room temperature (22° C.) The latter property could be a shortcoming because many of the objectional odors developed in finished plastics have a high vapor pressure and would emanate readily from the article at room temperature. It follows that a masking agent should be effective within the full volatility range of the objectionable odor.

The following statements represent properties which are specific to vanillin itself and might cause difficulties when used in plastic, particularly if it were used at a loading of 0.5-1.0% concentration where it would be moderately effective. Because it is a phenolic, it could present a discoloration problem either due to contact with traces of metals or sometimes in itself as a carrier of metallic ions. A 1% vanillin concentration in a clear film would show yellowing on short aging. Being also an aldehyde, it is subject to oxidation in alkaline media. This oxidation tends to form quinones which have a high coloring potential.

The Sindar Corporation, one of the foremost manufacturers of industrial aromatics, informs me that they have found synthetic chemical compounds more adaptable to use in formulation. They claim that their performance can be measured more accurately and, compared with the natural odor producing ingredients, do not contain the impurities nor do they vary due to selection from different sources, climates, etc. Their chemists use the synthetic ethyl vanillin wherever it would be necessary to achieve a specific perfume type. An example would be a baby talc odor which is sweet rose heliotrope, based on vanillin and other components.

Aside from the facts already mentioned about vanillin, it is limited in scope as a basic material. It has been found valuable as a blender, modifier, or fixative at small concentrations in other mixtures.

Another manufacturer in this field is Fritzsche Bros., Inc., of New York City.

•

New Applications . . .

. . . of a familiar material—glass filled alkyds, previously discarded as being difficult to mold, have been improved and are finding applications as transfer molding compounds. Some of the latest formulations are being marketed under the trade name Glaskyd, by Glaskyd, Inc., Perrysburg, O., and are supplied in weighed and cut preforms or as continuous rope.

The General Die Mold Co. of Chicago, Ill., is transfer-molding this material in a multiple-cavity mold for the Sarkes-Tarzian Corp., Bloomington, Ill. The molded parts are used for coil strips and stator bars in a newly designed television tuner.

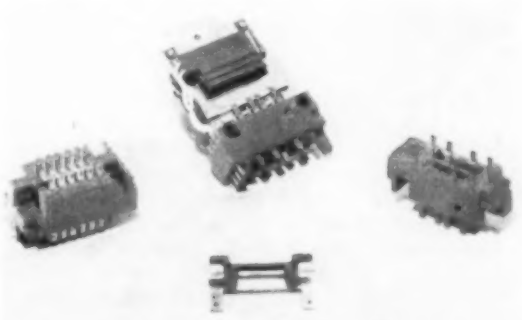

Photo courtesy: International Business Machine Corporation.

I.B.M. Corp's. glass filled alkyd parts used on their permissive make relay.

(*Continued on page 71*)

Appendix to "Silicone Aerosols as Mold Releases"

A feature article in our December 1958 issue was "Silicone Aerosols as Mold Releases," by A. R. Morse, of Injection Molders Supply Co. In a special author's note on the first page (p. 1116) of the article, Mr. Morse invited comments from "anyone who can correct or amend this article with additional facts."

Two such comments received here and transmitted to Mr. Morse are printed below, together with the author's replies. These letters and their replies are self-explanatory, and are printed in the interests of accuracy and the need for acknowledgment.

Dear Sir:

We have read with interest Mr. A. R. Morse's article on "Silicone Aerosols as Mold Relseases" in your December issue. We appreciate very much the complimentary references which Mr. Morse has made to fluorinated hydrocarbons in general and our product, "Freon" fluorinated hydrocarbons, in particular.

However, we were dismayed when our eyes fell upon the footnote indicating that the word "Freon" has come by usage to signify fluorinated hydrocarbons. The Du Pont Company has made an enormous investment in advertising this familiar trademark, and it is widely known in both the aerosol and refrigerant industries as Du Pont's name for its brand of propellents and refrigerants. Du Pont's competitors have adopted different trade names and no one, to our knowledge, is using "Freon" as a common name for fluorinated hydrocarbons.

C. S. Oldach, Dir. of Sales,
Freon Products Div.,
Organic Chemicals Dept.,
E. I. du Pont de Nemours, Inc.
Wilmington, Del.

Dear Mr. Oldach:

Art Merrill and I have discussed the problem of replying and acknowledging the letters we have already received and which we expect to receive in connection with my article on the Silicone Aerosol business. It is our intention at the present time to group together all of the comments and corrections and changes and to publish them in the form of an addenda to the article all at one time. It will make a most interesting commentary on my attempt to record the history of this industry while we are still in the mist of it.

In connection with the word Freon, we have an etymological problem. I am afraid that in spite of your efforts, it has become something like the word Kodak. I hear the aerosol industry discuss and discuss it myself, and unfortunately we repeatedly hear the word Freon used apparently with a small "f" to cover the generic family of fluorinated hydrocarbons. This is unfortunate in a way and good in another way.

I know that when I am discussing these products professionally with the people in the industry and use the word Freon to refer to fluorinated hydrocarbons, I am sometimes corrected and my confrers say that the Freon with a capital "F" is the du Pont trade mark and proceed to reel off a reminder that freon with a capital "F" is the du Pont trade name for its product and that there are others on the market.

In spite of this, I repeatedly hear the word used generically and in spite of the fact that you say no one is using freon as a common name for fluorinated hydrocarbons, I hear it on the plant level everyday and I am sure that you are misinformed in this connection. In spite of anything we can do, I am afraid that the common man is going to gravitate to the word freon rather than to fluorinated hydrocarbons and

based on what I hear every day, a good many people whom your advertising does not reach refer to fluorinated hydrocarbons as freon.

We will make every effort to correct this and will see that your letter is given full publicity and the misunderstanding corrected and explained as you request. As I said, we expect to hear from nearly everyone in connection with every phase of this business before we are through and it will be much more interesting to group the replies into one informative and corrective article.

Thank you very much for setting us straight in this connection.

Very truly yours,
INJECTION MOLDERS SUPPLY CO.
A. R. Morse
Sales Engineer

Dear Sir:

The excellent article in your December 1958 issue entitled "Silicone Aerosols as Mold Releases," by A. R. Morse, was read here with a great deal of interest. As a longtime manufacturer of a product of the type discussed, we would like to make several comments.

Although our product, REAL-EASE, is listed as one of the "johnny-come-lately" imitators, this is not, in fact, the case. As with many inventions, when the need is apparent and the materials are available, the development takes place independently at several locations at the sime time. REAL-EASE was developed for our local market in 1949 and early-1950, and was an article of interstate commerce in 1951. It is completely a product of our laboratory tests, field tests, and market survey. Chronologically, REAL-EASE predates the marketing of a silicone aerosol mold release under the IMS label, and predates Dow-Corning's Slipicone by several years.

The article correctly states that proper formulation and proper delivery to the mold surface are the prime requisites of a good product. Excellent formulations were developed early in the history of the silicone aerosol industry, and no new materials or substantial changes in quality of those already in use have appeared to change the picture appreciably.

The history of the delivery mechanism, the aerosol valve, is another matter, however. Here, the plastics industry has played a most prominent role. The original valves were primarily made of metal; an extruded dip tube was the only plastic part. Some of these had excellent delivery characteristics, but mechanical breakdowns and rejects were frequent. Gradually, plastic parts replaced the metal ones so that it is now possible to obtain valves whose only metal part is a spring. The plastic parts have not only permitted the production of more uniform valves with fewer rejects, but have cut the valve price almost in half.

That the stake of the plastics industry in the aerosol market is not a small one is indicated by some interesting statistics. Over four hundred million aerosol cans were filled in 1957, and the estimate is even higher for 1958. Well over one billion individual plastic pieces are now produced per year for the aerosol market.

M. C. Borovik, Pres.
Borco Chemicals, Inc.
Chicago, Ill.

Dear Mr. Borovik:

Mr. Art Merrill of PLASTICS TECHNOLOGY has been kind enough to forward me your letter of January 2nd. We will be most happy to make the corrections indicated in your letter and appreciate your valued comments. In preparing the article I had to go by such information as was furnished to me by the Silicone people and by customers who gave me dated cans and the first date I had of a silicone release under your label was 1952 and was handed to me by a molder in Chicago, who told me that this product had just appeared on the market. Naturally, we want to correct all points of error and fact and it is Mr. Merrill's intention to accumulate this information and present it as addenda to the article. I expect we will hear from almost everyone connected with the silicone aerosol business before we are through.

Yours very truly
INJECTION MOLDERS SUPPLY CO.
A. R. Morse
Sales Engineer

We also wish to apologize for two errors, on p. 1116, where reference was made to "silicone atoms." These were errors in proofing; as any chemist knows, these should have been "silicon atoms" since there are no silicone atoms — silicone molecules, yes, but not atoms. —THE END

New Applications of a Familiar Material

(Cont'd. from page 69)

Another company using this material is the International Business Machine Corp., Poughkeepsie, N. Y., who finds that high production rates are possible due to the material's fast setting quality.

The alkyd-glass parts used in the relay were run in two-cavity transfer molds, at a temperature of 315-320° F. The total cycle time was approximately 1½ minutes with a 40-second cure. Shrinkage was approximately four mils per inch. The parts showed excellent dimensional stability at heats and humidities normally experienced in enclosed electronic equipment. Another reason for the choice of the material was its good color retention which made possible its use for color coding.

Other users of this material report that it molds well under low pressure and, being free-flowing, will not distort or move delicate inserts. Electrical and electronic parts including switch gear and meter bases also are being manufactured from Glaskyd molding compound. —THE END

Machinery Maintenance
(Cont'd. from page 51)

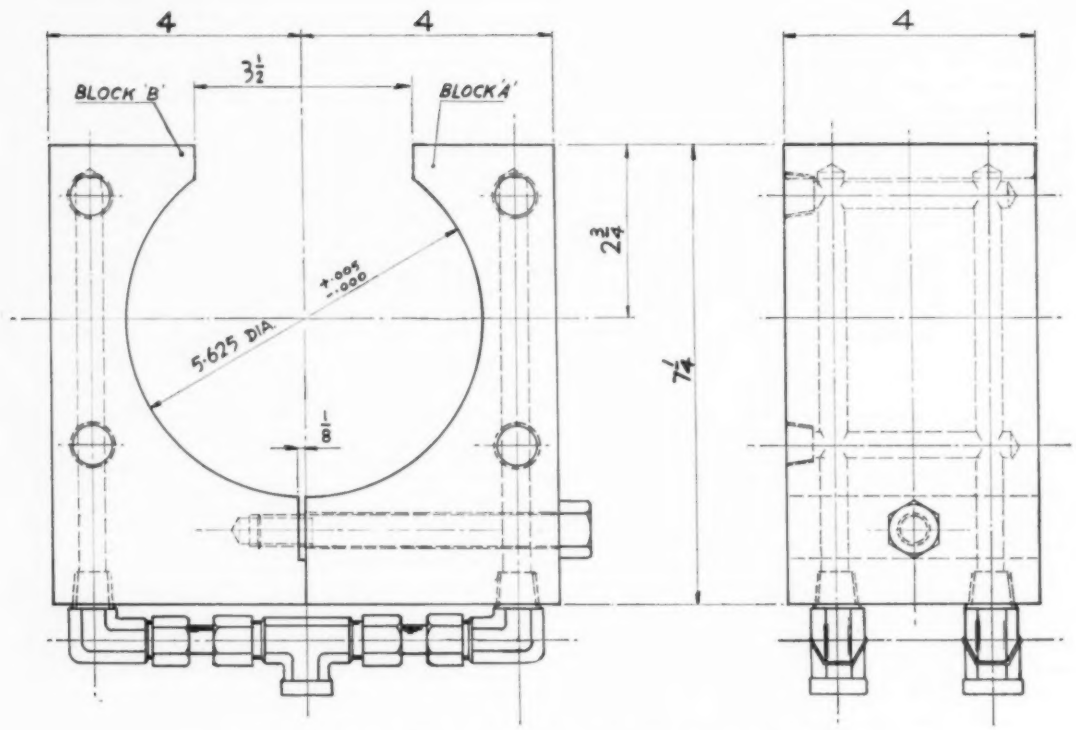

Diagram of cylinder cooling jacket. Dimensions are in inches.

Resin Characteristics Relating to Laminate Behavior

(Cont'd. from page 48)

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—THE END

News of the Industry

corporate changes and new companies

Formica Corp. has appointed a number of independent fabricators of industrial plastic laminates in a move to set up a field manufacturing organization. Selected fabricators from all major market areas of the United States will stock industrial sheets, tubes, and rods; thus serving all users of laminates. This program will be backed up by complete engineering and technical assistance from the factory.

Cincinnati Milling Machine Co. recently set up a division for custom molding reinforced plastics parts, **Cimastra.** This division has developed a process for incorporating pigmented fibers which either match or contrast with the color of the resin. Varied cross-sectional thicknesses can be obtained, maintaining the critical resin-reinforcement ratio. Sharp radii, flanges, and intricate shapes are said to impose no restrictions on Cimastra molded parts.

Eastman Chemical Products, Inc. has formed two new groups within its plastics division which will expedite the flow of information from laboratory to industry: the plastics sales development section and the technical information section. Headquarters for both will be Kingsport, Tenn.

Columbian Carbon Co. has appointed **B. E. Dougherty Co.** as its West Coast representative for carbon blacks, iron oxides, lamp blacks, dispersions, and plasticizers. The latter firm maintains offices in Los Angeles and San Francisco, and has six technical salesmen covering the general area.

Union Carbide Corp. recently announced the following changes in corporate management: Morse G. Dial, president, assumes the newly-created office of chairman of the board and continues as chief executive officer; Howard S. Bunn, executive vice president, becomes president; Kenneth H. Hannan continues as executive vice president, and vice president Birny Mason, Jr., becomes executive vice president.

American Can Co. has consolidated the operations of its two former subsidiaries, **Sun Tube Corp.** and **Bradley Container Corp.** Their activities will be continued by the newly-formed Bradley-Sun division, which will include the manufacture and sale of the plastic and metal tubes formerly conducted by the two subsidiaries.

A. O. Smith Corp. has formed a reinforced plastics division with James F. Donnelly, Sr., as general manager. The division will manufacture plastic pipe, among other products.

Glidden Co.'s chemicals-pigments-metals division has decided to channel all West Coast sales activities through its own offices at strategic locations. Ralph B. Quelos will serve as sales manager.

Waljohn Plastics, Inc. has served relationship with **Studner-Kavaler Co.,** and will now distribute luggage, case coverings, and Tourex extrusions directly to the customer. Ed Schlang will serve as engineering sales manager, Martin Dohren as production manager, and Martin Muckler as liaison between sales and production.

Shell Chemical Corp. has formed four, new fully-integrated divisions, bringing the total to five: agricultural chemicals, ammonia, industrial chemicals, plastics and resins, and synthetic rubber. The plastics and resins division will be headed by Martin Buck, and will functionally direct the operation of an appropriate portion of the Houston, Tex., plant.

Dow Chemical Co. has invested $2,300,000 in **Catalin Corp. of America** by purchasing a subordinated convertible note. Proceeds from the loan are largely earmarked for expansion purposes. Amortization payments are scheduled to commence April 1, 1971, and the loan is convertible at the lender's option to Catalin common stock at $8.50/share.

sets dylan nomenclature

Koppers Co., Inc. is offering Dylan polyethylenes in a new and broader spectrum of densities and melt indices. The second and third digits of the new Dylan number series indicate the melt index to the nearest whole number. The series from 1000 through 4000 cover a wide range of uses in extrusion of pipe and film, injection molding, and bottle blowing. Series 1000 covers applications in conventional low-density ranges; the 2000 and 3000 series represent resins with greater stiffness; and the 4000 series indicates resin with densities of 0.931 and higher.

TINUVIN® P

protects against ultraviolet radiation

TINUVIN P (CH3457) is a new *Benzotriazole* Ultraviolet Absorber for protection of plastics and other products affected by actinic radiation. TINUVIN P combines superior light, heat and chemical stability with maximum ultraviolet absorption without yellowing. *(pat. appl.)*

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company and plant expansions

Dal-Vir Products, Inc., long a Styrofoam fabricator, is currently fabricating pipe and fitting covers from the material. Markets for the product include dairies, breweries, meat packing plants, air reduction units, and chemical facilities, where water—vapor resistance and temperature insulation are important factors. The firm is located in Elkhart, Ind.

Monsanto Chemical Co. has completed an expansion project which makes available 25% more phthalate ester plasticizers. This is the third major expansion of these facilities within the past five years. The firm markets more than 70 different plasticizers, the large majority being phthalate esters. At the same time, Monsanto announced completion of a 40-million pound increase in the rated capacity of the styrene monomer plant in Texas City, Tex., making it one of the largest styrene monomer installations in the world.

Puratize, Inc., a subsidiary of Gallowhur Chemical Corp., Ossining, N. Y., has developed a process for rendering plastic materials bacteriostatic, and plans to license the process to molders and manufacturers of molding compounds. The new development is an expansion of a Gallowhur process for treating textiles, and should find use in garbage cans, bathroom fixtures, and floor tiling.

Reichhold Chemicals, Inc. has equipped its Ballardvale, Mass. plant for the manufacture of 10-million pounds of acrylic emulsion per year. This includes a new line of products for the surface coating and leather finishing industries and puts RCI among the leading producers of this material. The emulsions will be called Acripols, and are reported to feature very fine particle size and stability.

M. C. Gill Corp., plastics laminators of South El Monte, Calif., are presently installing facilities which will permit their entry into the field of metal honeycomb construction for the aircraft and missile industries. The third major expansion in three years, this move will add another 9,000 square feet of space to the firm's 18,000 existing feet.

Ace Plastic Co., plastic fabricators and extruders, has announced plans to enter heavy industrial and extrusion fields. Coinciding with these expansion plans, Ace has named Richard W. Halverson as chief extrusion engineer, and Louis Flynn as production manager.

Tri-Point Plastics, Inc., Albertson, N. Y., recently expanded its facilities by 30% to meet increased demands for precision-machined plastics. The firm reports an 80% increase in business for the past year, particularly in Teflon machining for the aircraft and missiles fields.

Du Pont's Film Department plans to increase its manufacturing capacity for Mylar polyester film by 30%. Additional facilities are being erected near Circleville, O., and should be in operation early in 1960. This will be the second major expansion since commercial production began in Circleville in 1954.

Chemo Products, Inc. is expanding its sales organization to meet increased demands for its line of insulated tapes and coated yarns, and most specifically for its new line of fluorocarbon products. In addition to existing representation, the firm is lining up new areas and additional sales personnel. Headquarters for the firm is West Warwick, R. I.

plastics color coding

Colorite Industrial Dyers, New York City, are offering a dyeing service for plastic parts which, reportedly, does not affect the tolerances. Color coding is particularly valuable in circuit identification, matching housings, and for special effects. Parts are dyed to comply with RETMA color coding standards as specified in GEN 101 A.

west coast borden epoxide distributor

Hastings Plastics, Inc., Santa Monica, Calif., now carries Borden Chemical's line of epoxide resins in production quantities. Designated Epiphens, the five resins are based on novolac - epichlorhydrin reactions.

hooker mold patent

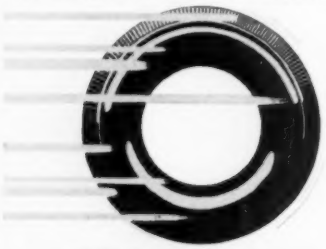
Hooker Chemical Corp. has been issued U. S. patent 2,865,052, entitled "Vented Mold for Plastic Materials." Inventor was the late Grayson W. Wilcox, of the Durez Plastics division. The patent covers a precision-built vent plug, which releases gases automatically from certain plastic molds thus preventing distortion or "doming" of the molded piece. Formerly, interruptions of the molding cycles were required in order to release entrapped gases.

The patent has been applied to the manufacture of plastic bases for electronic tubes and for plastic jar covers where the part must be molded flat to permit stacking. The device is now being manufactured by **Alpha Screw Co.,** Arlington, Mass., under a licensing agreement with Hooker.

COLLOID CORNER

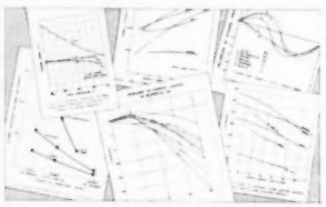
SEPTILLIONS IN THE HAND

...your hand can hold one septillion (a trillion trillions) Columbian colloidal carbon particles. A bead no larger than the period at the end of that sentence can contain 4,300,000,000,000 particles of uniform size and characteristics!



MILLION DOLLAR IDEAS

for the use of these minute particles include the strengthening of rubber. Some kind of phenomenon (not chemical reaction) causes reinforcement... adds great strength and wearability.



MULTIFOLD CHARACTERISTICS

result from sizes as small as 7 millimicrons. Take surface area, for example: One pound has the surface area of 30 acres. Or electrical conductivity: There are enough "electrical circuits" in a cubic inch of colloidal carbon to circle the world 10 times.

Columbian carbons—and iron oxides, too—of such small uniform size and pre-determined surface characteristics may have important uses in *your* industry. Write... tell us your area of interest.

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DEPT. A

News of Industry (Cont'd.)

new plants and laboratories

E. I. du Pont de Nemours & Co. will be producing linear polyethylene at its Sabine River Works plant in Orange, Tex., by mid-1960. The firm has operated a pilot plant there for the past three years and will go into commercial production upon completion of new plant facilities. Jobs will be provided for 50 additional employes. The new materials will be known as Alathon linear polyethylenes.

U.S. Industrial Chemicals Co. has officially opened its new compounding plant at Tuscola, Ill., with an initial capacity of 25-million pounds per year. The unit will compound Petrothene polyethylenes with carbon black and other additives for electrical and pipe resins.

Jefferson Chemical Co. has opened an ethylene plant at Port Neches, Tex. The new facility triples the firm's productive capacity for ethylene, doubles its ethylene glycol output, increases by 50% its production of ethylene oxide, and permits Jefferson's entry into new fields based on ethylene and propylene.

Ultra Plastics, Inc. has leased approximately 15,000 square feet of ground floor space in a modern, industrial building at 28th and Parrish Sts., Philadelphia, Pa. Previous location of the plastics and aluminum manufacturer was 2601 N. Howard St.

Bel-Art Products has opened its new plant in Pequannock, N. J., on Industrial Road. The old address was West New York. Production, stocking and shipping facilities have been increased three-fold, and the latest in machinery and equipment have been installed. Bel-Art manufactures plastic laboratory ware of all types, plus tubes & rods and plastic sheeting.

Structoglas division, International Molded Plastics, Inc. has completed the construction of a new plant in Grand Junction, Tenn. Designed on a "straight line" concept, the plant receives raw materials at one end and ships the finished product from the other. With processing in between, the system makes full use of the building's 35,000 square feet of floor space. Up to 100 local residents will be employed in producing the fiberglass-reinforced panels.

Tube-Kote, Inc. has begun construction on a $250,000 pipe coating plant near Midland, Tex. Scheduled for completion by mid-March, the facilities will have a coating capacity of 10,000 feet of pipe per day. It will employ between 30 and 35 men. In addition to the internal coating of oil field tubular goods, the plant will provide facilities for such industrial coating applications as corrosive control, refining, food processing, and transportation.

Reynolds Chemical Products Co. has scheduled a new plant for the production of Reynosol plastisol coatings and Reynofoam urethane foams. Covering 60,000 square feet of floor space, the unit doubles the size of previous Reynolds facilities in Ann Arbor and Ypsilanti, Mich. The firm is a division of Stubnitz Greene Corp., Adrian, Mich.

Adhesive Tape Corp. has acquired a pressure-sensitive adhesive manufacturing plant at 58 Seabring St., Brooklyn, N. Y. Constructed at an original cost of over a half million dollars, the facility includes the latest in industrial electronic control instruments. The Adheco line includes adhesive tapes, liner tapes, and rolls.

Reichhold Chemicals, Inc. has announced the beginning of construction of a $5-million chemicals plant in Elizabeth, N. J. Scheduled for completion late this year, the unit will produce some 30-million pounds of phthalic anhydride annually. Production will be by the fluid catalyst technique, which is said to ensure top quality material. Reichold is both a major supplier and user of phthalic anhydride.

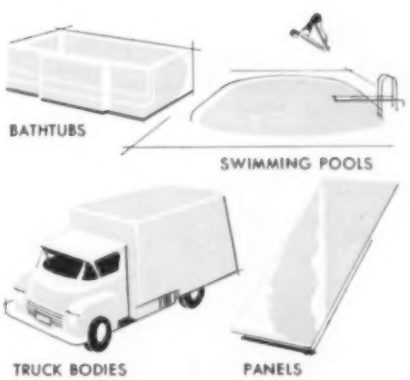
For hand layup molding of boats and other plastic products . . .

New GLIDPOL 1022 polyester resin system cures faster, speeds up production!

You can increase production rates per mold with new GLIDPOL 1022. This rigid, medium viscosity resin system contains a built-in accelerator that develops cure rapidly after gelation. Reinforced plastic parts cure to handling hardness in less than an hour at room temperature, quickly freeing molds for subsequent parts.

The GLIDPOL 1022 system is ideally suited to the manufacture of boats, bathtubs, sinks, swimming pools, truck bodies, panels, tanks, caskets and other products by the hand layup technique. And because GLIDPOL 1022 is specially treated during processing, the typical residual odor associated with room temperature cured parts is greatly reduced. To facilitate application to vertical surfaces, GLIDPOL 1022TX, a slightly thixotropic modification of GLIDPOL 1022, is also available.

Write for complete data on the GLIDPOL 1022 system, GLIDPOL resins for other fabricating techniques, and colorful, fade-proof GEL-KOTE coatings—pigmented resins that suppress fiber pattern with a smooth, durable surface that is an integral part of the finished molding.



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Plasticizer Data
TO HELP YOU CHOOSE THE RIGHT PLASTICIZER

this
Harflex® Plasticizer
is efficient

Dimethyl sebacate

extreme efficiency • excellent low temperature properties

Appearance	Clear Liquid or White Solid
Color, APHA	100 max.
Odor	Neutral
Specific Gravity 30/20°C	0.986±0.003
Free Acidity, as Acetic Acid	0.02 max.
Ester Content	99.0% min.

major uses:

A plasticizer in vinyl resins, synthetic rubbers, cellulose nitrate, cellulose acetobutyrate, acrylic resins; as a chemical intermediate, and a neutral, concentrated source of the sebacyl radical.

Harchem produces a full line of phthalate, adipate, sebacate and polymeric plasticizers. The Harchem Division laboratories will gladly assist you with your plasticizer problems, or will supply additional data including formulation test results and formulation suggestions for any Harflex Plasticizer.

Additional Inquiries to Dept. H-41.73

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M-32

WALLACE & TIERNAN
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news from abroad

Resinas Sinteticas, Lda. has opened the first synthetic resin plant in Portugal just north of Lisbon. The company is associated with **Reichhold Chemie AG** of Hamburg, Germany, and Reichhold Chemicals, Inc., of the U.S.A. Included in the 14-acre factory area are a pilot plant, a modern laboratory, offices, workmen's quarters, and a hospital. The plant is already producing a number of Reichhold resins under the American firm's formulas and technical know-how.

Polypropylene for Piping

Recent tests carried out in Italy on Moplen polypropylene pipe with an interior diameter of about one inch, gave results indicative of very interesting possibilities. The outstanding property proved to be the substantial degree to which mechanical strength is maintained at temperatures around 100° C. At that temperature, bursting load was still at least 30% of the bursting load at 22° C. In addition, tubing made from Moplen of molecular weight about 22,000 or over, showed high impact resistance at ambient temperature, and resistance to embrittlement by polar liquids (environmental stress cracking).

In a comparison test, bursting pressure of Moplen pipe was three to four times higher than that of Fertene (low-density polyethylene) pipe. The limiting working temperature of the latter was around 50° C., but the bursting load for Moplen at 100° C. was at least equal to that of Fertene at ambient temperature. Moplen had lower mechanical resistance than PVC at temperatures up to 70° C., but above this temperature (which is considered to be the upper working limit for PVC), Moplen still retained a large part of its mechanical strength.

To increase impact resistance at temperatures around 0° C., polyisobutylene was added to Moplen piping compound with encouraging results as to increased resilience. Reduction of original bursting strength was limited to 20% when the polyisobutylene content (in high-isotactic Moplen A2) did not exceed 10%.

During extrusion, a difference in molecular orientation takes place. This shows up as a difference in impact resistance values in tests along axis in different directions. This difference varies in intensity with the type of material, but also depends on extrusion conditions. Studies on these influences are still in progress.

Long-term tests on Moplen pipe have not been completed as yet, but results of one experiment can be mentioned. Here, two tubes—one of high-density polyethylene and the other of the moderately-isotactic Moplen M2—were installed over a winding length of 12 meters. The first specimen cracked in several places after conveying running water for a month at slightly above atmospheric pressure, or at 20-90° C., whereas the Moplen pipe showed excellent resistance for more than 22 months under the same conditions.

News of the Societies

Seated at the speaker's table at the ISO/TC 61 meeting are: (left to right) Vice Admiral G. F. Hussey, Jr., Henry St. Leger, G. M. Kline, C. L. Condit, Mrs. Gern-Hess and Mr. Morales.

ISO Technical Committee 61, Plastics, Meets in Washington

Fifty-six delegates of the International Standards Organization gathered November 3-8 at the Willard Hotel, Washington, D.C., to attend the 1958 meeting of Technical Committee 61. This committee, composed of eight Working Groups, operates within the structure of ISO, to establish internationally acceptable standards for evaluation of plastics materials. Twelve nations were represented.

The conference was opened with short statements delivered by ISO general secretary, Henry St. Leger, and Admiral G. F. Hussey (USN ret.), managing director of the American Standards Association.

Approximately 35 items were discussed by the various Working Groups which met in 14 sessions. Working Group 1 completed editorial revisions on its list of 800 equivalent terms pertaining to plastics technology. Known as Draft ISO Recommendation 177, this document will be submitted to the General Secretariat in Geneva, Switzerland, together with a final report for ISO Council approval. Probably it will be available as a published standard in mid-1959.

Working Group 2 recommended that a German method for determining dynamic mechanical properties of plastics be circulated as a first draft proposal; and that ASTM D 638-56, Tensile Properties of Plastics, take the form of a second draft proposal. The Secretariat of ISO/TC 61 was asked to suggest to the Secretariat of the Metal Testing Standardization Committee that early consideration be given to terms and definitions for specimens used in testing. This should promote use of the same or equivalent nomenclature when testing plastics and metals. The group currently is evaluating Izod and Charpy impact tests, hardness and compression tests, as well as one for modulus of elasticity.

Tentative plans for a paper on methods of measurement and control of relative humidity in large and small enclosures were considered by Working Group 3, who proposed that ISO/ATCO prepare a document on the subject based on the experience and needs of interested technical committees. Committee approval was obtained to circulate as a first draft recommendation, the former third draft proposal on standard atmospheres for conditioning and testing of plastics. Other methods under study by Group 3 include: conditioning of polyamides; and relative humidity.

A method for establishing the melt index of polyethylene compounds was advanced as a first draft recommendation by Working Group 4, and the Vicat softening point test method was recommended for circulation as a first draft proposal. Among the studies undertaken by this group are a test method for stiffness in torsion, methods for determining flammability, and new flow techniques for thermoplastic and thermosetting materials.

Working Group 5 put forward two first draft proposals. One was a method for determining the viscosity number of polyamide resins in solution, and the other for determining acetone soluble matter in phenolic molding materials. Currently under study are procedures for determining the gel time of polyesters, determining the chlorine content of vinyl chloride polymers and copolymers, and methods for testing the viscosity loss of polystyrene and cellulose acetate.

Working Group 6 is pursuing an active study program in the fields of biological attack, resistance to light, change in mechanical properties after contact with chemical substances, and environmental stress cracking.

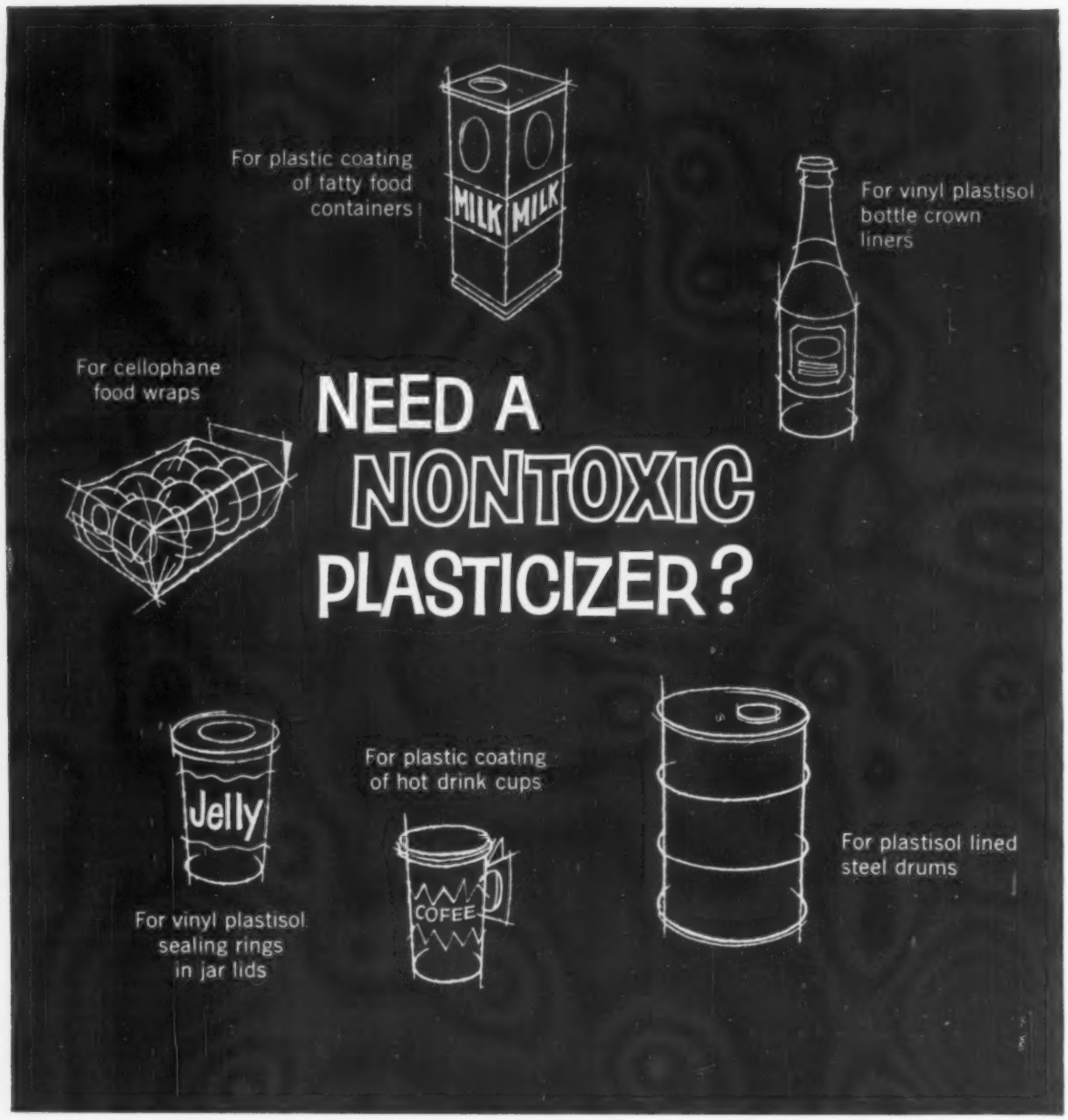
Committee approval was obtained by Working Group 7 for three first draft recommendations. These include recommended practices for: compression molding test specimens of thermoplastic materials; compression molding test specimens for thermosets; and injection molding test specimens for thermoplastics. Future work will encompass the detailed design of a positive, semi-automatic mold for thermosetting test specimens based on a Swedish mold design. Procedures for preparation of stress-free, orientation-free plates as well as the necessary molds also are under consideration.

TC 61, on the advice of Working Group 8, approved circulation of the draft method for determining the comparative tracking index of solid insulating materials under moist conditions, Document IEC 15 (Central Office) 8, as a first draft ISO proposal. Working Group 8 serves in a liaison capacity between ISO/TC 61 and IEC/TC 15 (International Electrotechnical Committee) Electrical Insulating Materials. It reviews methods developed by IEC/TC 15 and advises what action should be taken by ISO/TC 61. Included in the group of TC 15 methods under study by Working Group 8 are: conditioning, corrosion effects, insulation resistance, thermal stability, dielectric strength, dielectric constant and loss, and tracking.

Following the 1959 meeting, which will be held in Munich, Germany, from October 26-31, the leadership of Working Group 2 will be transferred from Germany to the U.S., and leadership of Working Group 7 will be transferred from this country to Poland. Cooperative work on test methods for cellular materials between ISO/TC 45, Rubbers, and ISO/TC 61 Plastics, is being contemplated, and at the closing plenary session initial steps were taken to organize a Working Group 9. Their activity will be limited to specifications, based on current commercial practice as reflected in national standards, for identification and quality control of plastics materials.

SPI Tooling Division

At the invitation of the Ordnance Tank-Automotive Command, U.S. Army, The Society of the Plastics Industry, Inc.'s Tooling Division presented a symposium on plastic tooling. Held October 28-29, 1958, at the Detroit Arsenal Auditorium, Centerline, Mich., the program included the presentation of five papers, four plastic tooling demonstrations, and tours of Ford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Citroflex A-2 (Acetyl Triethyl Citrate) for cellulosics is especially suited for use in plastic food wraps such as cellulose acetate packages for processed meats, doughnuts, etc.

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After introductory remarks by Major General Nelson M. Lynde, Jr., commandant, and John H. Garrett, Department of Defense, the following papers were presented: "History of Plastic Tooling," Professor O. D. Lasco, Purdue University; "Plastic Tooling Fabrication: Necessary Facilities, Equipment, Materials, and Program," Robert H. Voss, Voss Plastics, Inc.; "Plastic Applications in the Metal Working Industry," W. J. Esdale, Allied Products Corp.; "Plastics in the Foundry," W. Weaver, Modern Pattern and Plastics Co.; and "Future of Plastic Tooling." A. Juras, Plastic Development and Research, Inc.

SPE Baltimore-Washington

SPE's Baltimore Washington section met January 13 at the Hot Shoppe, Langley Park, Md., for a round-table discussion on the "Role of Chemical Finishes for Glass Fibers in Reinforced Plastics." H. A. Perry, Naval Ordnance Laboratory, moderated the program.

Participants in the discussion included: John Rutzler, Case Institute of Technology; Fred J. McGarry, Massachusetts Institute of Technology; M. A. Jellinek, Union Carbide Corp.; and George Stein, A. O. Smith Corp. The presentation was designed to clarify problems involving the chemical and physical mechanisms which deposit finishing agents on fibers; the role of finishes in protecting fibers against natural and industrial atmospheric deterioration; factors governing rate and completeness of wetting fibers by resins; protecting fibers from moisture; effect of finishes on curing rates of resins; and influence of finishes on adhesion.

New York Pigment Club

The New York Pigment Club, which holds its meetings at New York City's Fraunces Tavern, has announced election of its 1959 officers, and a schedule for its spring programs. New Officers are: president, Herbert H. Johnson, H. Kohnstamm & Co.; vice-president Robert U. Copeland, L & R Organic Products Co.; secretary, Robert E. Brouillard, General Dyestuff Co.; and treasurer, Peter Ricciardi, E. I. du Pont de Nemours & Co.

Speakers and topics for the spring meetings include: February 11, "Nacreous Pigments and Metallic Effects," George E. Meyers, Rona Laboratories, Inc.; March 12, "Patenting Pigment Inventions," Milton Zucker, Esq., Sweedler & Zucker; and April 9, "Pigment Dispersions With Acetylene Derivatives," Emil A. Wich, General Dyestuff Co.

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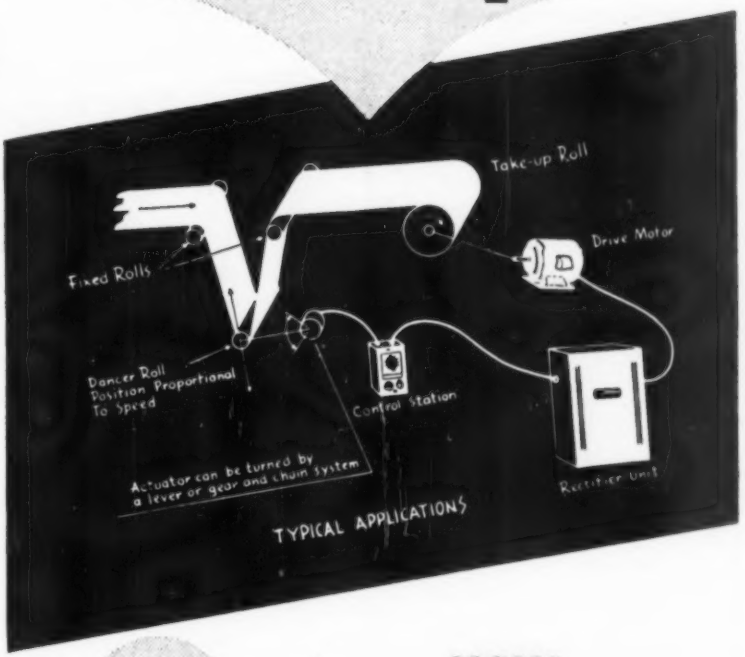

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A small tension change positions the actuator shaft so as to call for motor speed change to restore preset tension. Thus a constant linear feet per minute windup may be achieved even though the radius of takeup roll increases with each turn to otherwise increase linear speed versus radius build-up. Speed is now made proportional to position of dancer roll and tension is held essentially constant, as is the linear rate of material travel.

These and other models of electronic motor speed control systems available from 1/50th to 2 horsepower.

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SMD-3500

A free-flowing polystyrene compound offering both excellent moldability and fast set-up. Along with low bulk factor, this material provides good electrical, mechanical and optical properties. Widely used for injection molding operations.

TMDA-6000

A high-impact, rubber-modified polystyrene with low bulk factor, free flow and quick set-up. Izod impact strength is as much as 5 times that of general-purpose styrenes.

TMDA-9001

Good flow and fast set-up are combined in this medium-impact, rubber-modified polystyrene. Surface gloss and translucency are excellent. Widely used for caps, closures and containers.

RMD-4511

Possesses exceptional resistance to chemicals and high heat, as well as unusual flexural and tensile strength properties. These make this acrylonitrile-styrene copolymer ideal for surface hardness, dimensional stability and rigidity in service.

TMDB-5161

In addition to a high heat distortion point, this high-impact, rubber-modified polystyrene affords superior mechanical strength and good electrical properties. An outstanding material for radio cabinets and similar applications. Molds with good flow and release; set-up is fast; surface gloss is superior; colors are excellent.

TMDB-2155

A rubber-modified polystyrene with extra-high impact strength even at temperatures of −25° C. **Strongest rubber-modified styrene on the market today!** Molding properties are excellent; ease of flow at molding temperatures; fast cycles; good mold release; and a minimum of strains and weld lines.

Which styrene would you choose for this product?

"BAKELITE" PLASTICS
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VINYLS • EPOXIES • STYRENES
C-11 STYRENES • PHENOLICS
POLYETHYLENES • IMPACT STYRENES

THE PRODUCT:

Domestic food waste disposer encased in a sound-deadening, molded plastic shell. Designed by Waste King Corporation, this "Super Hush" model is quieter—lighter, easier to install—combines attractive colors with durability. Molded by Industrial Molding Corp., Culver City, Calif. and Modern Plastic Co., Los Angeles, Calif.

THE PROBLEM:

Pick a plastic which affords ease of molding to the "sculptured" design desired. In addition, provide for chemical inertness, resistance to heat, and excellence of color and lustre. Above all, provide for durability in service with properties of high impact strength.

THE SOLUTION...

to this manufacturing problem is in the *wide selection* of BAKELITE Brand Polystyrenes. If you selected TMDB-5161 as your choice for this "Waste King" Pulverator you matched up properties to performance requirements *exactly* as countless of fabricators are doing every day with BAKELITE Brand Plastics.

For the right styrene to meet *your* needs exactly, discover the full range of BAKELITE Brand compounds. And, to assist you in your selection, call on the services of your Bakelite Company Technical Representative—or write Dept. BQ-29G.

In addition to the styrene molding materials described at left, Bakelite Company provides for your selection these others:

SMD-3000 (unmodified heat-resistant Styrene)
SMD-3700 (high-flow Styrene for containers)
RMD-4500 (high-clarity Acrylonitrile-Styrene)

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Names in the News

Gerald S. Kennedy has been elected chairman of the board of directors, for General Mills, Inc., a post vacated by the retirement of **Harry A. Bullis.** Mr. Bullis has served as board chairman for the past ten years, and will continue to serve as a director and member of the executive committee. Mr. Kennedy has been a member of the board since 1948, and was named executive vice president last September. Prior to that date, he served as administrator of basic commodities activities. The board also elected **A. D. Hyde, A. Z. Kouri,** and **E. O. Boyer** as executive vice presidents.

Spencer M. Wright has been named manager of the new Mechanical Industries division of Markem Machine Co., Keene, N. H. He will be assisted by **Gus Marshala** and **George Zahos.**

Robert M. Aude has been appointed vice president and general manager of Heyden Chemical division, Heyden Newport Chemical Corp. He left Monsanto to join the firm in 1953 as manager of the Fords plant, after which he became manager of the plant in Garfield, N. J.

Val Reisig has been appointed assistant to **Dennis C. Guthrie,** advertising manager of Eastman Chemical Products' plastics division, and will maintain offices in New York City. A former member of Union Carbide's plastics market program, Mr. Reisig has been active in both the SPI and the ACS.

David A. Yoemans, an industrial engineer, has been added to the research and laboratory staff of M. C. Gill Corp., plastics laminating firm located in South El Monte, Calif. He formerly served as plant superintendent of Rez-Coat and division manager of Fabricon Products.

E. O. Barstow and **R. L. Curtis** have retired as members of Dow Chemical Co.'s board of directors. Mr. Barstow also retired as vice president, but remains with the firm in the newly-created position of honorary chairman of the board. Mr. Curtis simultaneously retired as general manager of Dow's Western division, but retains a vice presidency and will remain a senior officer on the West Coast. Elected to replace the two retired directors are **Donald K. Ballman,** director of sales, and **C. B. Branch,** manager of the plastics department. Replacing Mr. Curtis as Western divisional manager is **Leland A. Doan,** assistant general manager since 1955.

Harry D. McNeeley, vice president of Tennessee Eastman Co., has been named executive vice president of this Kodak division. Mr. McNeeley also becomes vice president of three Eastman subsidiaries which have headquarters in Kingsport, Tenn.: Eastman Chemical Products, Inc., Holston Defense Corp., and Holston Trading Corp. In addition, he will serve as vice president of the Texas Eastman Co., Longview, Tex.

E. S. Nickerson has retired as general manager of Du Pont's fabrics and finishes department after 43 years of service. He is succeeded by **Walter F. H. Mattlage,** assistant general manager.

Louis K. Eilers

Louis K. Eilers has been named first vice president of Tennessee Eastman Co. and the Texas Eastman Co., divisions of Eastman Kodak Co.; and president of the marketing unit, Eastman Chemical Products, Inc. The former vice president and assistant general manager of the firm, Dr. Eilers succeeds **William S. Vaughn,** who has been elected vice president and general manager of Eastman Kodak.

W. E. Maclean has been named to succeed **A. J. Bruno** as head of the engineering and maintenance department at W. R. Grace's Polymer Chemicals division plant in Baton Rouge, La. Mr. Bruno becomes special project manager for copolymer processes. Mr. Maclean most recently served as project manager for Grace research and development in New York. Prior to that, he held the positions of project manager and plant engineer for the Davison Chemical division.

W. D. Holland

L. J. Francisco

R. A. Hoekelman has been appointed director of customer relations for American Cyanamid Co. He previously, had served the firm as comptroller, assistant treasurer, and general manager of the plastics and resins division. In another appointment, **L. J. Francisco** was named general manager, a direct promotion from assistant. He had spent his entire business career with Formica until the merger in 1956. Still another job change finds **W. D. Holland** replacing Mr. Francisco as assistant general manager of the division. He is the former assistant general manager of the firm's commercial development division.

Robert C. Kuder has been appointed director of research and development for the Mol-Rez division of American Petrochemical Corp. Dr. Kuder served as research chemist with Standard Oil of Indiana, assistant professor of chemistry at the University of Dayton, supervisor of polymer research for Allied Chemical Corp.'s plastics & coal chemicals division, and most recently as technical director of Bemis Bros. Bag Co.

George R. Mitchell has joined Glastic Corp. as director of materials development engineering. His responsibilities will include the development of new resin systems for use under adverse environmental conditions. Dr. Mitchell most recently served as chemical development manager for Olin Mathieson.

Robert A. Brenneck and **Charles R. Given** have retired from service with Union Carbide Plastics Co., after 45 and 32 years, respectively. Mr. Brenneck joined the firm in 1911 as a file clerk, and advanced through technical correspondent to Midwest district manager and surface coatings sales manager on the Pacific Coast. Mr. Given sold for various other plastics companies before joining UCC, and has sold Bakelite plastics on the East Coast since 1926.

New Materials

Write item numbers on Readers' Service Card (p. 99.) to obtain more information.

Cleaning Fluids

A water-wash detergent and a degreasing solvent, known respectively as Blast 1 and Blast 2, are being marketed by Narda Ultrasonics Corp. Blast 1 is a blend of anionic and non-ionic detergents, sodium silicate and sodium polyphosphate. Odorless and non-flammable, this detergent promotes cavitation, reduces surface tension, outgasses entrained air, and protects against redeposition of soil. It is added in quantities of ½-ounce per gallon of water and is recommended for ultrasonic cleaning of optical parts, precious metals, and other assemblies which can be cleaned in aqueous solutions.

A solvent of the inhibited trichloroethane type, Blast 2 is non-flammable, contains no carbon tetrachloride, and is the least toxic of all chlorinated hydrocarbon solvents. It dries quickly, leaving no residue. Moisture-free, this material promotes vigorous cavitation and is used without dilution on parts where the soil is of oily, greasy, or waxy nature.

Readers' Service Item 1

Flame-Retardant Laminate

A self-extinguishing, paper base, phenolic laminate called Fireban 321 is available from Taylor Fibre Co. Essentially an XXXP grade, this material exceeds the Underwriters Laboratories specifications for flame retardance. Fireban 321's flame-out time is three seconds.

Standard sheet dimensions are 49 by 49 inches, and thicknesses available range from 0.020-0.25 inch. The sheets are maroon with a semi-gloss finish and exhibit the following properties:

	Thickness, in.	
	1/16	*3/32*
Flexural strength, lengthwise, min., psi	17,000	17,000
Crosswise, min., psi	13,000	13,000
Dissipation factor, 1 megacycle, Cond. A	0.028	0.028
Cond. D-24/23	0.030	0.030
Insulation resistance, megohms	250,000	350,000
Dielectric loss factor, 1 megacycle, Cond. A	0.126	0.127
Cond. D-24/23	0.138	0.144
Water absorption, Cond. D-24/23, %	0.60	0.40

Readers' Service Item 3

Ultraviolet Light Absorber

An ultraviolet light absorber, which can be incorporated easily into most polymeric materials, is being marketed under the tradename Cyasorb UV 24, by American Cyanamid Co. Although this material has been found effective in vinyl, polyethylene, cellulose acetate, and surface coating resins, it is expected to find its primary application in thin vinyl and cellulose acetate films, and in surface coatings.

Cyasorb UV 24 is slightly acidic because of the phenolic groups in its structure. With bases, it usually forms yellow colored salts which have reduced light stability. Acidification, however, restores the original color. Cyasorb can be added to monomers which are polymerized by peroxide catalysts without affecting the reaction. It absorbs 300-380 millimicron wavelengths most effectively, and gives a partial absorbtion between 380-400 millimicron wavelengths. Typical properties include:

Molecular weight, theoretical	224.24
Boiling point, (0.5-1.0 mm. Hg.) °C.	160-170
Melting point, °C.	68-70
Solubility, gms./100 gms. at 100° C.:	
Benzene	46.6
Butyl acetate	38.1
Carbon tetrachloride	22.2
Ethyl alcohol (3A)	21.4
Hexane	2.3
Methyl ethyl ketone	55.3
Water	0.0013
Xylene	30.6
DOP	16.6
DOS	14.8
HB-40*	13.6
TCP	20.7
TOP	31.1

*Partially hydrogenated mixture of isomeric terphenyls, trademark Monsanto Chemical Co.

Readers' Service Item 5

Epoxy Adhesive

A single component, epoxy adhesive, designed for high temperature applications, is being marketed under the tradename Isobond 321 by Isochem Resins Corp. In its uncured form, it is a brown, trixotropic paste exhibiting a specific gravity of 1.21 and a viscosity of 1,800-1,900 poises at 25° C. A short heat cure is required to form a strong bond which is stable at 200° C. and sometimes higher. It adheres well to metals, ceramics, glass, cement, and to other temperature-stable materials, while showing an outstanding chemical resistance to most fluids. Typical properties of the cured adhesive include:

Specific gravity	1.12
Volume resistivity, ohm-cm.	3×10^{12}
Dielectric strength, volts/mil*	400
Dielectric constant, 25° C., 10^6 cycles	3.8
Dissipation factor, 25° C., 10^6 cycles	0.02
Operating temperature range, °C.	−55 to +200

* 20-mil sheet.

Readers' Service Item 2

Catalyst for Urethane Foam

A special grade dibutyl tin dilaurate catalyst, tradenamed Niax Catalyst D-22, has been made available by Union Carbide Chemicals Co. A clear, pale yellow liquid, this material makes possible one-step production of polyether-based urethane foams by accelerating the chain extension reaction of polyethers with toluene diisocyanate.

Niax D-22 has a tin content ranging, by weight, from 18-19.2%. Chlorides, calculated as NaCl, are present in concentrations not greater than 0.5%. The catalyst can be masterbatched with polyols, water, surfactant, and a tertiary amine to give a clear mix. The batch should be used within 24 hours as storage data have not been obtained as yet. Physical properties of this material include:

Specific gravity	1.066
Weight, lbs./gal.	8.87
Flash point, °F	440
Coefficient of expansion, 55° C.	0.00084
Viscosity, 20° C., cps.	45.3
Refractive index	1.4680
Freezing point, °C.	8

Readers' Service Item 4

Heat Reactive Phenolic Resin

A heat-reactive phenolic resin which imparts excellent green tack, high tensile strength, and a high thermal softening point to nitrile rubber adhesives, is being marketed by Schenectady Resin Division, Schenectady Varnish Co., Inc. Designated SP-12, this resin is described as a fast curing, oil soluble, crushed phenolic. It is completely compatible with nitrile rubber, and is soluble in aromatic or aliphatic solvents.

SP-12 imparts good color fastness to the adhesive as well as a significant increase in its tensile strength. Usually mixed in equal quantities up to 100 parts each, the resin can be blended with premilled rubber and solvents, or milled directly into the rubber before cold cutting.

Readers' Service Item 6

Polymeric Plasticizer

A polymeric plasticizer which imparts permanent flexibility to a broad range of general-purpose PVC applications is being marketed under the tradename Santicizer 409, by Monsanto Chemical Co. Chemically, this material is a polyester derived from adipic acid, and has a molecular weight in excess of 2,000.

In appearance, Santicizer 409 is a clear, viscous liquid, which has a very faint ester odor. Its electrical resistivity and permanence under heat aging recommend its use in wire coatings and film for electrical tape. Exhibiting high resistance to extraction and migration, as well as high compatibility under humid conditions, this material is characterized by the following physical properties:

Acidity, milli-equiv./100 grams	0.6
Color, Gardner	1
Moisture, %	0.05
Pour point, °F.	40
Refractive index	1.4654
Specific gravity	1.084
Viscosity, poises, 25° C.	30
Efficiency factor	1.30
Weight, lbs./gal.	9.04

Readers' Service Item 7

VANSTAY*

Vinyl heat and light stabilizers

Our trademark of 14 years standing came into being with VANSTAY L, the first nontoxic light stabilizer for Vinyls.

Today, the VANSTAY* line includes a number of materials developed to keep pace with Industry's demands for higher temperature Vinyl protection in process and in service.

Expanded research and technical service can be of immediate assistance in solving your Vinyl stabilization problems.

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R. T. Vanderbilt Co., Inc.

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High Melt Viscosity Nylon

A high molecular weight, high melt viscosity nylon has been introduced by Spencer Chemical Co. Designated Spencer Nylon 607, the resin is said to offer processing advantages to producers of film and extruded shapes, and to blow molders. Since the high melt viscosity imparts handling characteristics similar to polyethylene, it can be extruded commercially as 0.25-mil film.

Blown-film extruders can expect greater drawdown, easier bubble handling, and better wind-up characteristics. High melt viscosity gives greater strength to the molten polymer during set-up both for film and for shapes and profiles. SN 607 also has the inherent operating-temperature range of Nylon 6. Solution viscosity of over 800 is almost triple that of other commercially available nylons (300).

Physical properties for the material are reported as follows:

	Moisture content	
	0.3%	2.9%
Tensile strength, psi.	12,300	9,600
Yield strength, psi.	12,300	7,000
Elongation, %	210	220
Impact strength, Izod.	0.9	5.3
Flexural strength, psi.	15,500	4,000
Flexural stiffness, psi.	265,000	73,000
Heat distortion point @		
66 psi., °F.	367	
At 264 psi., °F.	150	

Readers' Service Item 8

Liquid Stabilizer for Vinyls

A heat and light stabilizer which has a "leveling-out" effect on non-uniformities in flexible vinyl compounds, (caused by oxidation or hydrolysis), has been introduced by Harshaw Chemical Co. Called Stabilizer 6-V-2, the material is a compatible, modified barium-cadmium liquid reportedly unsurpassed in retention of properties during storage, compounding, processing, and in finished stock.

Stabilizer 6-V-2 stands up under the following accelerated tests for oxidation and hydrolysis: expose 10 grams on a 6-inch watchglass to air; watch for crystallization, separation, and gellation; reweigh contents for loss of volatiles; compare with unexposed specimen for efficiency, compensating for neutral volatiles lost. In the hydrolysis test, 100 grams are measured into a 150 cc beaker and covered with 10 grams of water; this is allowed to stand for 24 hours, and compared with an untreated sample.

The following physical properties are reported:

Metals content, %	10
Color, Gardner	12
Viscosity, Gardner	A2
Specific gravity	1.06
Flash point, °F	185

Readers' Service Item 9

RIGID or FLEXIBLE...

URETHANE FOAMS PERFORM BETTER, LAST LONGER WITH **WITCO FOMREZ® RESINS**

Top-quality urethane foams are a natural with Witco's new Fomrez resins. Adaptable to a wide range of foam densities, they are easy to handle and outstandingly uniform, insuring the highest degree of batch-to-batch reproducibility. There's a Witco resin for every type of foam, both flexible and rigid. Mail coupon for details.

FOR FLEXIBLE FOAMS

Witco Fomrez No. 50... Witco Fomrez No. 70

For the production of high-quality flexible urethane foams, adaptable to both "one-shot" and prepolymer foaming systems. Widely applicable in industries such as automotive, aviation, furniture, clothing, packaging, bedding, sports equipment, and many others.

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Foaming systems for producing low to high density rigid foams possessing excellent structural strength, uniform cell structure, heat and dimensional stability. Can be foamed in-place by batch, continuous or intermittent machine-mixing or spray-foaming methods. *Rigid foam uses:* thermal insulation (refrigerators, freezers, pipes, tanks, etc.); structural reinforcements (core material for structural sandwich panels, wall panels, etc.); potting or encapsulation of electric components; flotation equipment.

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REPEATABILITY OF CYCLES

Type D765 ROBOTRON* Timer—the complete timing control for plastic molding presses. Panel is so simple that any possible cycle sequence can be set up in as short a time as 10 seconds, without particular skill or familiarity.

CHECK THESE FEATURES:
Completely Packaged Unit • Airtight Enclosure • Rapid Setup • Cycles Quickly Changed • Extended Rangeability • Enclosed Electrical Component • Plug-in Elements • Etched Circuits

Taylor-Emmett **NEV-R-GRIND*** *Valves mean* **NO WARPING...NO FOULING**

Three-Way (E380) and Two-Way (E370) Valves are fully balanced, cylinder operated, compact and have excellent capacity. Available in 3500 and 6000 psi. body ratings. Both are normally operated at 35 to 50 psi. air pressure.
Fully balanced design permits application of pressure to any port connection. Type E370 is available either normally open, or normally closed. Sizes 1" to 4".

Type D532 Cylinder-Operated Valve is half the size of conventional valves, has one quarter the parts. Extremely compact and maintenance-free. 750 psi. Sizes ½" to 2½". Normally open: normally closed: 3-way semi-balanced.

Call your Taylor Field Engineer, or write Taylor-Emmett Controls, Inc., Akron, Ohio, or Taylor Instrument Companies, Rochester, New York.

*Trade-Mark

Taylor-Emmett Controls, Inc.
A SUBSIDIARY OF Taylor Instrument Companies

Synthetic Pearling Agent

A synthetic pearling agent, described as a non-toxic bismuth compound, has been placed on the market by Rhodia, Inc. Known as Perlex 100, this material can be incorporated directly into the resin before extrusion or compression, or applied as a surface coating after having been suspended in a lacquer.

Perlex 100 contains an effective screening agent, and its light stability is achieved only after incorporation into the plastic. It produces the desired pearlescent effect when used in quantities ranging from 0.5-5.0% by weight. Optimum concentration for most purposes is found to be in the region of 1.0%.

Readers' Service Item 10

Phthalocyanine Blue Pigment

A non-flocculating phthalocyanine blue pigment, exhibiting an exceptional jet masstone with a bright greenish undertone, is being marketed under the tradename Solfast Blue G 43100, by Sherwin-Williams Co.'s Pigment, Color, and Chemical division. This pigment disperses well and can be used as a primary, or mixed with yellows to make cleaner greens.

Solfast Blue G 43100 is easy to grind, and incorporates the non-bleeding, heat and light resistance characteristics common to the phthalocyanines. Its full shade Munsell notation is 8.8PB 1.17/2.9.

Readers' Service Item 11

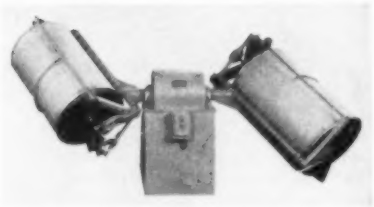
Epoxy Casting Resin

A relatively low-viscosity, black, epoxy-base, liquid casting resins is being marketed under the tradename Hapex 1225 Maskast, by Hastings Plastics, Inc. Usually used with the company's Hapex 1226 Tufset, this material cures at room temperature to make large section castings. The reaction takes place with little exotherm and no shrinkage. Viscosity at 72° F. is 31,000 centipoises, and the specific gravity is 2.141.

Readers' Service Item 12

New Equipment

Write item numbers on Readers' Service Card (p. 99.) to obtain more information.



Ball & Jewell dual drum tumbler.

Dual-Drum, Dry-Color Tumbler

A dual drum tumbler for dry coloring called the Tumble-Master is available from Ball & Jewell, Inc. Constructed of extra heavy steel, it handles two drums measuring 28 to 33 inches in height, simultaneously. Floor level loading is standard.

The Tumble-Master has a hand wheel adjustment for down height, as well as a positive lock with a quick release. The operator simply slides the drum onto the drum bracket. Other features include an oversized shaft with SKF ball-bearing pillow blocks and a ratio motor drive with secondary sprocket and roller chain drive.

Readers' Service Item 21

Temperature Control Pyrometer

After considerable, successful field testing, Illinois Testing Laboratories, Inc., is offering its Alnor Pyrotroller to the plastics and allied industries. A pyrometer controller, it can be used wherever a thermocouple can be inserted to measure temperatures.

Electronic pyrometer temperature controller.

The Alnor requires only ½-square foot of panel space, and can be flush- or semi-flush mounted. Only one electron tube is used to operate the relay and to be responsible to the command of the temperature indicator. This electron tube performs as an oscillator which can be stopped by the use of sufficient negative feed-back.

When the negative feed-back path is uninterrupted, the electron tube cannot oscillate at all, but passes a large amount of plate current and causes the relay to pull in. When the negative feed-back path is interrupted by a small aluminum loop on the indicating pointer, the electron tube oscillates and will not pass appreciable plate current. For this reason, the relay will not pull in and will not close the control switch.

Pyrometer wires are easier to install than capillary tubing, and can be bent around sharp corners, cut, and spliced. Different styles are available weighing 9¼-11½ pounds. Where special control problems require two target settings, the Double-Target Pyrotroller FB-4S-14 should be used. Extremely compact, it can be placed in the smallest conduit housing.

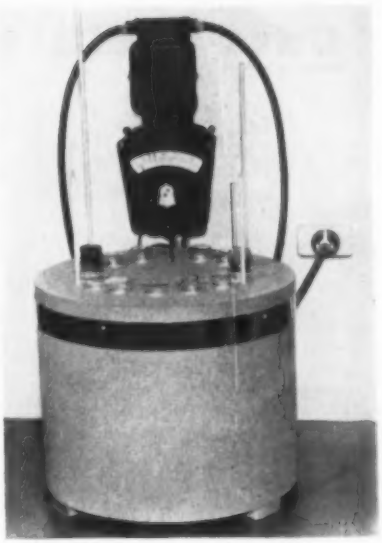
Readers' Service Item 22

Accelerated Aging Test Unit

A precision testing device for determining the aging characteristics of plastics, rubber, and similar materials under closely controlled temperatures ranging from 100-600° F. has been developed by Product Packaging Engineering. Called the Comet Model 600 Aging Block, the unit is available from the C. P. Hall Co.

The Comet is equipped with 13 individual test tube compartments, and operates on 220-volt a.c. current. The five 500-watt heating elements are built-in to prevent noxious fumes. A Partlow Indicating and Proportioning-Type Thermostat Control assures exact temperatures, and an additional built-in temperature control acts as a cross check or override for the master control unit. Body is aluminum with a removable bottom plate for easy access. All external parts are of baked enamel and are chrome plated.

Any substance which can be placed in a 38-mm by 300-mm test tube and capped can be tested in the Comet. Weight of the unit is approximately 169 pounds; its diameter is 18 inches; and its height is 17 inches. The controls weigh about 10 pounds.

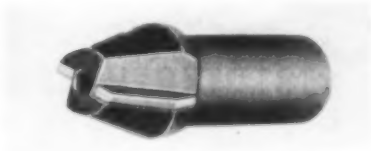


Comet Aging Block and controls.

Readers' Service Item 23

Carbide Tipped Trim Tools

Two carbide tipped tools for plastics finishing, one for bevel trimming and the other for edge matching, have been introduced by North American Products Corp. Both incorporate two-wing design, and the bevel tool is ground with cutting angles of 15, 30, 45, and 60°. Shank diameters are ¼, 5/16, or ½-inch.



North American's bevel trim tool.

Readers' Service Item 24

Rigid PVC Expansion Joint

Walworth Co., has added a rigid PVC expansion joint to its line of PVC valves, strainers, and pipe fittings. Maximum traverse of the joint is four inches, which will compensate for variations to that length for long, straight runs of both normal-impact and high-impact PVC pipe. These variations occur due to changes in temperature.

Specially designed O-rings assure an

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Walworth rigid-PVC expansion joint, open and closed.

absolutely tight seal. The joint will hold at pressures which are well above five times the maximum recommended pressure for the equivalent size Schedule 80 pipe.

Readers' Service Item 25

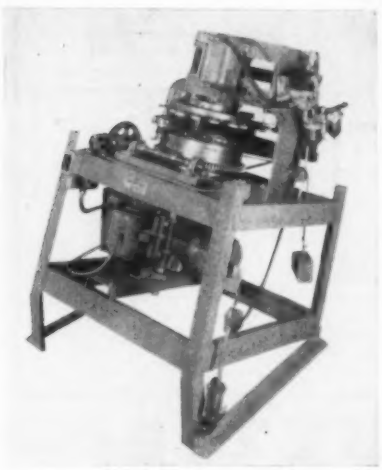
Automatic Flash Trimmer

Both internal and external edges of molded plastic products can be finished with an automatic flash trimmer and contour forming machine which is being manufactured by Gaynes Engineering Co. Although the output of this unit varies with the type of material, depth of cut, and the contour of the part, certain items can be finished at rates up to 600/hour.

After being placed on a rotary table, the molded part is centered in position by a fence at the rear of the machine. A starting button is pressed and an electric solenoid lowers an air-driven piston onto the work to hold it firmly while the cut is being made. As the piston lowers, it trips a micro switch which raises the locating fence so that the part can rotate freely. At the same time, a second micro switch starts the drive motor which rotates the work table, and a motor driven cutter-head automatically moves in to bear against the part. After 1½ revolutions, the drive motor shuts off, the pneumatic piston raises, and the finished part rolls through the machine to a stock pile or conveyor belt. In doing so, the part actuates a micro-switch which lowers the locating fence for the next positioning.

Of inclined, open-back construction to facilitate part removal, the machine's frame is made of all-steel welded components. The cutter holder rotates at 6,000 rpm., and is belt-driven by a one horsepower, 3,600 rpm. electric motor. The cutter-head is designed to hold four carbide-tipped inserts which are so mounted that the clearance and rake angles remain constant for the entire life of the bit.

Custom built, the Gaynes trimmer is fitted with standard components to facilitate replacement, if necessary. All electrical controls and motors can be furnished for 220-, 440-, 550-volt; 60-cycle; three-phase current.



Gaynes Automatic Trimmer.

Readers' Service Item 26

Beside-The-Press Grinder

A plastics grinder, designed for beside-the-press use, has been introduced by Injection Molders Supply Co. Designated Model M-5, this machine features a 12-by 12-inch throat opening, and a snap-out screen cradle which facilitates cleaning.

Three rotor-borne blades, rotating at 450 rpm., mesh with two stationary blades to give a tangential shearing action which grinds without fluffing. Blade overhang has been increased to 1⅛ inches so that heavier sections can be cut without tearing or crushing. All blades are fully supported in a solid steel bed for impact resistance, and can be adjusted up to ⅜-inch.

The screen offers a 180° peripheral area for cleaner grinding. Both the screen cradle and hopper are hinged to expedite maintenance, and the hopper can be reversed so that the bin can be serviced without disturbing the press operator. Standard equipment supplied with this unit include: heavy gage material catch pan; front and top opening hopper lid; starter with overload protection; heavy duty casters; double V-belt drive; and 5-hp., 220/440 volt, 3-phase motor. Physical dimensions include:

Floor space, in.	28 x 44
Height, over-all, in.	60
Tray	51
Weight, lbs	1,250

Readers' Service Item 27

How to control your temperature...

Your personal temperature may soar when you see the advantages that others gain by improving control of temperature in operations like yours. But you can confidently control both types of temperature by using our consulting service and, if necessary, some of our instruments.

For we are specialists in temperature control. Our world-wide field force is constantly working with situations like yours, seeking waste and hidden potentials where "control is no problem." Working with your own people, chances are they'll find ways to boost your production...assure quality... reduce costs.

We provide such service without charge, to determine whether you really need our indicators or controllers or recorders, thermocouples and accessories. Chances are that you do; for our instruments soon save their cost in avoiding work-stoppage and reducing maintenance.

Proportioning Controller

Gardsman Model JP (shown) automatically adjusts On-time to Off-time to maintain any desired temperature within extremely close limits. Wide selection of Gardsman controllers provides for all control applications. All are tubeless, "solid-state" and proved in wide use. Phone your West consultant (see Yellow pages) or write Chicago office for Bulletin JP or for COM digest-catalog of line.

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Mold designers can reduce drawing board time by using D-M-E's full-scale Master layouts, which provide locations of leader pins, return pins, screws and other standard details. Complete catalog specifications and prices on 31 standard sizes—up to $23\frac{3}{4}$" x $35\frac{1}{2}$"—eliminate guess-work in estimating the cost of the mold.

But your savings don't end there: Moldmaking time is turned into dollars earned, because all the plates in the assembly are precision ground—flat and square—ready for the moldmaker's layout and machining (pictured above). The exclusive interchangeability of all D-M-E plates and component parts gives you the added saving of immediate replacement in case of emergency.

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Start saving now. . . with D-M-E STANDARD MOLD BASES!

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D-M-E STANDARD
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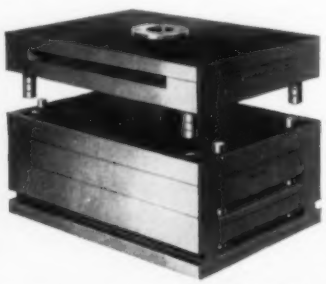

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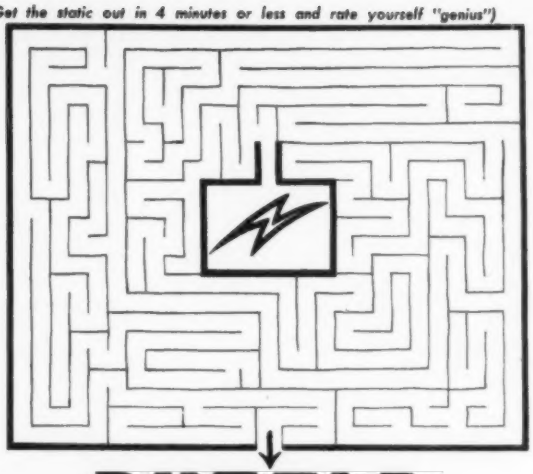
- D-M-E of CANADA, TORONTO, ONT.: 156 Norseman Ave.

(Get the static out in 4 minutes or less and rate yourself "genius")



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417 Canal St., New York, N. Y.

Plastics Applications

Write item numbers on Readers' Service Card (p. 99) to obtain more information.

Simmons' plastic-metal chair.

Plastic-Metal Chair

An outdoor-indoor chair, combining plastic and metal, has been designed for Simmons Co. by New York industrial designer Raymond Spilman. The construction features six modular cushions, spaced at ½-inch intervals, and cemented to bars which in turn are attached to a simple framework of steel or aluminum.

The cushions are made of vinyl foam by U.S. Rubber Co., using Union Carbide's Elastomer Process. In this method, unfoamed vinyl slurry is poured into a heated mold and then the foam is added. Upon the application of heat, the two vinyls fuse and cure to form an integral cushion which is both washable and weather-resistant.

Readers' Service Item 41

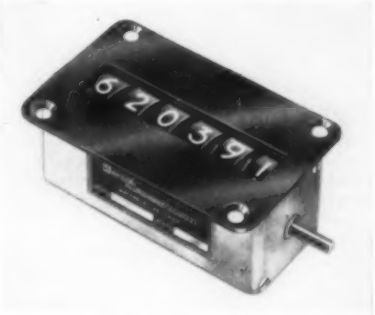
Vac-Tite polyethylene boxes.

Little Polyethylene Boxes

Impact-resistant Tenite polyethylene, product of Eastman Chemical Products, Inc., is being used in a series of circular boxes designed to protect lenses, bearings, small instrument parts, and electronic components during shipping and storage. Tradenamed Vac-Tite and manufactured by Clover Industries, Inc., these boxes consist of two mating halves which fit together to form a moisture-resistant drum capable of withstanding heavy blows.

Vac-Tite boxes have all of the acid, alkali, and oil resistant characteristics common to polyethylene, and are available in sizes ranging from ½-3 inches in diameter, and ½-⅞ inch in depth. Rigid ⅛ inch flanges around the top and bottom facilitate opening.

Readers' Service Item 42



Haydon six-digit, non-reset, non-reversing counter.

Planetary Gear-Driven Counter

A mechanical counter which uses a planetary gear drive to rotate the numerals, instead of the usual Geneva movement, has been placed on the market by Haydon Instrument Co. Called the Planet Gear, it employs a nylon cam and roller-compensating device for quick transfer of numbers. Since the gears are always in mesh, there can be no skips or misses.

The Haydon counter features a uniform low torque turning of the drums. Any device capable of turning the first numeral drum can drive the entire counter reliably, since there are no peak load points. The counting wheels can be driven at contin-

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SYNTHETIC
PEARL PIGMENTS
FOR COMPOUNDING INTO
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COATING ALL SURFACES
Rona Pearl Pigments are heat and light stable, non-reactive non-corrosive, and impart high pearly luster, exceptional depth and brilliance at very low cost.
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Model No. 3 Model No. 250
Model 250 ACROLEAF PRESS
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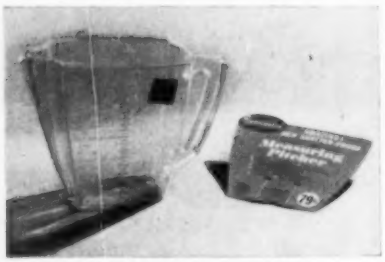
uous high speeds of 1,000 rpm. (10,000 counts per minute). Life tests have been run in excess of 100-million counts.

Bearings, gears, cams, and rollers are nylon. The main shaft is center-less ground, polished stainless steel. The large (5/16-inch) numbers conform to military specification MIL-S-33558 (ASG).

Readers' Service Item 43



Polymethylstyrene measuring pitcher.

Polymethylstyrene Measurer

Formulette Co., Inc., is marketing a 32-ounce pitcher which is both boilable and break-proof. Molded of American Cyanamid's Cymac 400, a polymethylstyrene, the pitcher has built-in markings on the outer surface indicating cup, ounce, cubic centimeter, pint, and quart graduations.

Patented features include a no-drip, hook-on pouring spout which fits over the edges of bowls and jars. Funnels are no longer needed. Obviously, the material used is clear so that the miniscus can be read, although Cymac 400 is also available in colors. The molder is Boonton Molding Co.

Readers' Service Item 44

Reinforced Polyester Boat

Atlantic Marine Industries has introduced an outboard motor boat made from glass fabric-reinforced Vibrin polyester, a product of United States Rubber Co.'s Naugatuck Chemical division. Called the Newport 17-Footer, this boat is molded in three, large, one-piece sections and incorporates a built-in flotation compartment which provides more than twice

Atlantic Marine Industries' Newport 17-Footer.

the usual safety factor.

The flotation compartment is permanently bonded to the hull, just below the waterline. It extends from stem to stern, and has 23 sealed channels which provide 18 cubic feet of buoyancy space.

Made in deluxe, standard, and utility versions, the first two models have two molded-in cockpits, connected by a walk-thru for safety and convenience. Other features include self-bailing engine wells, dual control mounts, double tank and battery molded-in hold-downs, underdeck dry storage tray, footrest, neoprene rub rail, and a full set of hardware. In addition, the deluxe model is equipped with a windshield and steering wheel. It is upholstered with Coast Guard-approved cushions which can be used as life preservers.

Readers' Service Item 45

Polyethylene Mower Parts

Phillips Chemical Co.'s Marlex high density polyethylene is being used to replace certain metal parts in three models of Toro Mfg. Corp's 1959 series of power

Toro's Whirlwind rotary mower.

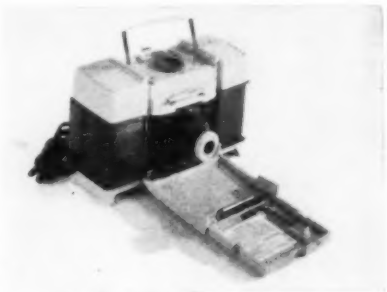
mowers. The 19- and 21-inch Whirlwind models, as well as the 21-inch self-propelled Whirlwind, have been outfitted with Marlex engine shrouds, discharge chutes, and deflectors.

Toro engineers, who wanted to replace fabricated sheet metal housings with plastic moldings, called in representatives of Flambeau Plastics Corp. After deciding on Marlex for its abrasion and weather-resistance, Flambeau and Phillips designed special multiple-gated, hot-runner molds to produce the parts. The Marlex shrouds prevent accidental burns, while the deflectors and discharge chutes act as shock absorbers in addition to their regular function.

Readers' Service Item 46

Urea Part in Photo Copier

Three pounds of Beetle urea plastic, product of American Cyanamid Co., are



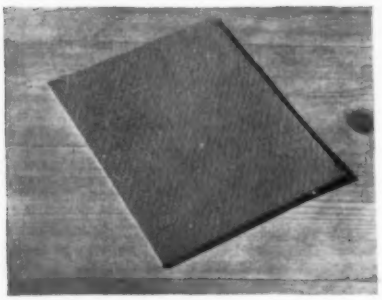
Polaroid portable Print Copier.

being used to mold 11 component parts of Polaroid Corp's portable Print Copier. This device, which is used in conjunction with Polaroid Land Cameras, delivers finished copy prints in 60 seconds.

The plastic parts, including the casing, have the detergent-, oil-, and grease-resistance common to the ureas, as well as their colorability. Compression molded in Stokes automatic molding machines, Print Copiers are light-weight, and have a lustrous, hard finish, as well as good durability.

In operation, the original print is placed inside the rear door of the Print Copier. The camera is slipped into position and a picture is taken of the print. Some corrections for exposure can be made with the Copier, and it is claimed that the duplicate picture can be better than the original.

Readers' Service Item 47



Velvetex vinyl clad foam rubber floor covering.

Vinyl-Rubber Floor Covering

A soft, stain-resistant floor covering, combining foam rubber cushioning with a patterned vinyl tread surface, has been introduced by E. I. du Pont de Nemours & Co. Called Velvetex, this material is recommended particularly for stairs, halls, entrances, and other areas where easy cleaning is important. Dirt will not penetrate the vinyl top side, and the carpeting can be vacuumed, swept, washed, or wiped clean.

Abrasion tests show that the surface is about twice as wear-resistant as a rubber floor covering; five times more resistant than a hair carpeting with sponge rubber backing; and almost six times greater than a wool carpet runner in the same price range. Velvetex is available in 27-inch wide rolls, in beige, green, or gray.

Readers' Service Item 48

Polyethylene-Lined Ice Bucket

An economical solution to the problem metal-icebucket sweating is offered by Towle Mfg. Co. The firm uses a liner of W. R. Grace's Grex high-density polyethylene, vacuum-formed by Gregstrom Corp. Sheet for the liner was extruded by Southern Plastics.

Metal ice bucket with polyethylene liner.

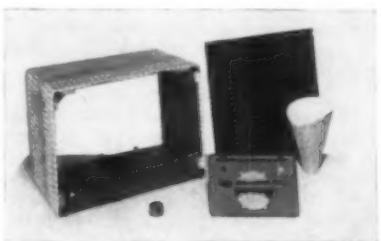
Tough, unbreakable, and easily cleaned, the liner is resistant to a wide range of temperature changes. Needless to say, it is unaffected by alcohol.

Readers' Service Item 49

Custom Vinyl Laminations

North-East Laminates, Inc. is currently offering a variety of prelaminated materials on a custom basis. The line is called Cladplate, and consists of vinyl laminated to such metals as steel, aluminum, magnesium, and to a variety of cores: plywood, hardboard, asbestos board, etc. The firm will apply the vinyl to the customer's material, or will supply Cladplate as a sheet cut to the customer's specifications, ready for fabrication.

Prime advantages claimed for Cladplate are its texture and color adaptability. Finishes include leather, woodgrain, woven, linen, and others. All colors, plus patterns and multi-color effects, are available. Surfaces will not mar, chip, or scratch, since a 2-mil thickness of clear vinyl is applied before embossing.



Parts fabricated from Cladplate vinyl laminates.

Readers' Service Item 50

Custom-Extruded PVC Channels

Waljohn Plastics, Inc., has instituted a custom service for flexible PVC channels used to provide a better, putty-less fit of glass and plastic sheets in all types of sliding doors, aluminum thresholds, shower doors, partitions, and door sweeps. These channels are extruded in different types, shapes, and dimensions to specifications.

Not only will the vinyl channels give during sudden changes in temperature (thus lessening breakage), but provide both weather and sound insulation. Colors add a decorative touch, and can be made to match or contrast. The three most common types are shown in the accompanying photograph: U-shaped, thin-walled, and beaded.

Three Waljohn PVC channel extrusions and an office wall partition using them at the sides and bottom.

Readers' Service Item 51

Styrene Aquarium

A light-weight, all-plastic aquarium, called Acqua-Flaire, is being manufactured and sold by the Wil-Nes Co., a leading manufacturer of aquarium products. The components are molded from Koppers Co.'s polystyrene—the sides are clear, while the base and top are offered in a range of decorator colors including black, gray, turquoise, and coral.

Weighing less than three pounds, Aqua-Flaire measures 15 by eight by 11 inches. It is illuminated with a standard tubular bulb, and can be purchased with optional equipment such as heating and filtering units, and decorating kits.

Wil-Nes Co.'s Aqua-Flaire.

Readers' Service Item 52

New Literature

Write item numbers on Readers' Service Card (p. 99) to obtain more information.

"Quality Laminates for the Electrical and Electronic Industries." New England Laminates Co., Inc. 3 pages. In outline form, this bulletin describes characteristics of the company's clad and unclad plastics laminates for the electrical and electronic industries.

Readers' Service Item 61

"Reynosol." Reynolds Chemical Products Co. 8 pages. This technical bulletin describes behaviour characteristics of Reynosol plastic coatings in several applications.

Readers' Service Item 62

"Pliolite S-6E." The Goodyear Tire & Rubber Co. 1 page. Three tables are used to describe the characteristics of Pliolite S-6E, one of Goodyear's styrene-butadiene formulations. Tabulated are: raw resin properties; molded resin sheet properties; and properties of a high resistivity formulation.

Readers' Service Item 63

"Vacuum Metallizing Coatings for Metal, Glass, & Thermosetting Plastics." Bee Chemical Co. 16 pages. Various coating applications procedures are described, in addition to those coatings used in conjunction with the vacuum metallizing process.

Readers' Service Item 64

"What is the Rubber Industry." The Rubber Manufacturers Association, Inc. 16 pages. This booklet contains brief narrative information and statistical data on the rubber manufacturing industry.

Readers' Service Item 65

"Products Service." Enjay Co., Inc. 3 pages. This leaflet gives material descriptions and specifications for Enjay's alcohols, olefins, diolefins, ketones, acetates, and ethers.

Readers' Service Item 66

"A Guide to the Products of BRP." British Resin Products, Ltd. 12 pages. Printed in English, German, French, and Italian, this booklet describes the firm's synthetic resins and plastics materials. These include adhesive and binder resins, surface coating resins, and plastics materials such as cellulose acetates, phenolics, polystyrene, and polyethylenes.

Readers' Service Item 67

"Cellofilm Nitrocellulose & Vinyl Solutions." Cellofilm Industries, Inc. 4 pages. Typical formulations are given the lacquer, ink, adhesive, textile and paper coating, and floor finish manufacturer. In addition, a short history of solution manufacturing processes is given.

Readers' Service Item 68

"Solithane 113." 11-58. Thiokol Chemical Corp. 4 pages. The material is a liquid urethane prepolymer designed for use in compounding elastomeric, semi-rigid, and rigid foams. Properties and processing data are listed.

Readers' Service Item 69

"Extrusion for Wire and Cable." WC-2. Polychemicals department, E. I. du Pont de Nemours & Co., Inc. 16 pages. Data, schematic drawings, and problems encountered in extruding Alathon and Rulan (flame-retardant) polyethylenes and Zytel nylon are included in this bulletin. The material on design of tubing and pressure dies represents the latest technology developed by Du Pont laboratories.

Readers' Service Item 70

"Catalin Antioxidants." Catalin Corp. of America. 12 pages. The oxidation mechanism is discussed from the point of view of free radical action. Detailed descriptions are given of the firm's antioxidants and their application in fuels, petroleum oils, plastics, rubber, and packaging materials. Tables list physical and chemical properties.

Readers' Service Item 71

"National Polychemicals, Inc." 8 pages. This booklet gives a brief history of the company, its products, and future plans. In the plastics field, the firm offers blowing agents, silicone mold releases, and ester plasticizers for vinyl resins.

Readers' Service Item 72

"1959 Guide to Dow Corning Silicones." Dow Corning Corp. 16 pages. Suggestions are given for cutting production costs, simplifying designs, improving performances, and boosting sales through the use of Dow silicone products. Uses and applications are listed along with tabular data and graphs.

Readers' Service Item 73

"G-E Phenolic Products." CDC-358. General Electric Co., Chemical Materials Department. 8 pages. This illustrated brochure describes and lists properties and uses for the firm's line of phenolic resins, varnishes, and molding powders. It should be of considerable interest to designers, molders, fabricators, formulators, and end-users.

Readers' Service Item 74

"Durez 16771 Natural." No. D 203. Durez Plastics Division, Hooker Chemical Corp. 6 pages. Properties, molding effects and techniques, shelf life, and applications are listed for this glass roving-filled phenolic. The booklet also advises on molding equipment and mold design, and includes many illustrations.

Readers' Service Item 75

"Comet Rotary-Vac Three-Stage Forming Machine." Comet Industries. 4 pages. Basic operation and specifications are given in this well-illustrated bulletin. Schematic drawings show vacuum snap-back, plug assist, blow-down vacuum reverse, reverse draw, male-assist pressure forming, and billow forming.

Readers' Service Item 76

"Ferro Colored Gel Coats for Reinforced Polyester Laminates." Color division, Ferro Corp. 7 pages. Properties and application techniques are given along with prices and a color chart.

Readers' Service Item 77

"Ferro Liquid Wax V-50 for Polyester and Epoxy Molding." Color division, Ferro Corp. The wax is used in conjunction with Ferro V-264 and V-28 parting films. Application techniques and prices are included.

Readers' Service Item 78

"The Use of Resin-Treated Clays in Reinforced Plastics." TSBT-84. Georgia Kaolin Co. 11 pages. Claims include: reduction of resin viscosity or greater loading, greater dispersion, reduced water absorption, improved physical properties, and no effect on pot life or cure time. Tabular and graphic matter is included.

Readers' Service Item 79

Book Reviews

"High Temperature Resistant Sealant Materials." L. C. Boller, G. M. LeFave, E. O'Brien, A. Milner, and J. H. Emigh, Coast Pro-Seal & Mfg. Co. for Wright Air Development Center, U.S. Air Force. Order PB 131478 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 26 pages. Price, 75c.

A sealant was developed by aircraft fuel tanks which is unaffected by JP-5 jet fuel in the 600-625° F. range. This material retained its flexibility and adhesion, and withstood proof testing under flexing and pressure at that temperature arnge. Butadiene-acrylonitrile rubber and phenolic resin systems were studied in an effort to develop the optimum thermal stability potential. Effects of antioxidants, leafing pigments, plasticizers, and other additives were investigated, along with the effectiveness of liquid polybutadiene and other coating systems.

"Fluorocarbons." Merritt A. Rudner. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Cloth, 5 by 7½ inches, 235 pages. Price, $5.75.

This book covers the properties, chemistry, processing and fabrication techniques, as well as final applications of fluorocarbon products. Capabilities and limitations of these materials as compared with other plastics are discussed, and case histories are used to show how the fluorocarbons can be used to solve specific problems.

Considerable attention is given to Teflon, Fluorothene, Kel-F, Genetron, Polyfluoron, and Enflon. Electrical, mechanical, and chemical applications are reviewed, and charts, graphs, and photos illustrate the text. Although not all-inclusive, the technical data are reliable, and it is believed that this is the largest compilation of information on the fluorocarbons yet available.

"Dispersion of Materials." Rolt Hammond. Philosophical Library, Inc., 15 East 40th St., New York 16, N.Y. Cloth, 5½ by 8¾ inches, 230 pages. Price $10.00.

The first two chapters of this book deal with the principles and practice of crushing, grinding, and classifying materials. Chapter three gives an account of fluidation with its industrial applications, advantages, and disadvantages. Froth flotation, extraction of base metals, and flotation equipment are among the topics included in the fourth chapter; while chapter five discusses liquid dispersions such as emulsion, solutions, gels, homogenizations, and separation of multi-component mixtures. Chapter six deals with the dispersion of gases and atmopheric pollution, and discusses the nature and cause of smoke-pollution, treatment of gaseous effluents, gas washers, dust collection, acid mists, and electrical resistivity of dusts.

"Separation and Purification of Materials." Rolt Hammond. Philosophical Library, Inc., 15 East 40th St., New York, N.Y. Cloth, 5½ by 8¾ inches, 327 pages. Price, $10.00.

This volume covers solid-solid, solid-liquid, solid-gas, liquid-liquid, liquid-gas, and gas-gas separation systems, and includes a final chapter on the peculiarities of purification problems in nuclear engineering. Atmospheric pollution by sulfur compounds and dust is given extensive treatment, and the author describes the main types of equipment that are available.

Magnetic separators, sieving operations, filtration, evaporation, and electro-precipitation are among the methods described for the separation of solids from the various media in which they may be entrained. The distillation section elucidates the several methods of separating liquids from liquids. It dwells particularly on catalytic cracking, molecular distillation, and solvent extraction. Centrifugal separation is treated, as well as the separation of gases by chromatography.

"Successful Process Plant Practices." Robert L. Davidson, McGraw-Hill Book Co., Inc., 327 W. 41st St., New York 32, N.Y., Cloth, 6 by 9 inches, 302 pages. Price, $10.00.

Based on more than 500 articles which appeared in Petroleum Processing magazine, this manual brings do-it-yourself type information to the operating engineer in the process plant. While most of this material was obtained at refineries, petrochemicals plants, and gas liquids plants, it covers many problems common to all processing industries.

The first four parts of the book discuss management, maintenance, handling processes and equipment, and equipment protection. Part five discusses general equipment, and describes tools and methods common to many plant activities. Practical working data are included, and more than 270 drawings and photographs illustrate the text. A reference list at the end of the book allows the reader to refer to the original items as they were published.

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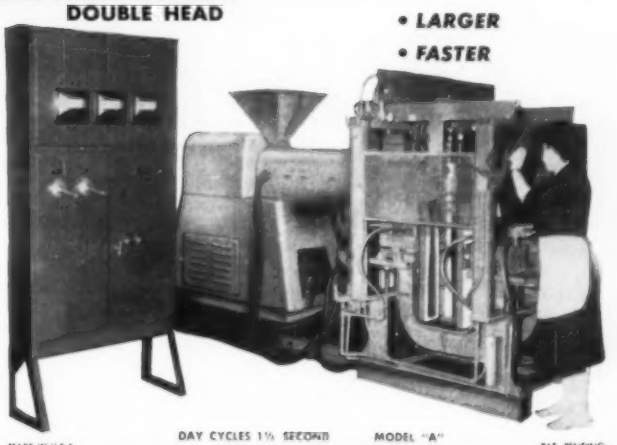

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Abstracts of Important Articles

Materials

"The Production of Methacrylic Resins," M. Maret, *Off. Matieres Plastiques*, 4, 41, 37 (Nov. 1957).

Non-technical outline of the various steps followed in producing methacrylic resins starting from acetone. (In French.)

"Improving Electrical Properties of Epoxies," John Delmonte and Kenneth Cressey, *SPE J.*, 14, 11, 29 (Nov. 1958).

The effects of curing agent, water and heat on electrical properties of a reaction product of bisphenol A and epichlorohydrin were determined.

"Tailoring Polymers for Electronics," C. L. Petze, Jr., *SPE J.*, 14, 12, 35 (Dec. 1958).

Silicone alloys can be formulated to meet specific electrical requirements.

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"Studying the Electrical Properties of Casting Resins," R. W. Warfield, *SPE J.*, 14, 11, 39 (Nov. 1958).

The use and results obtained with a continuous current monitoring instrument are given.

"Radiation: Plastics' New Tool?" R. F. Boyer, W. C. Goggin and Robert McFedries, *Western Plastics*, 5, 11, 31 (Nov. 1958).

The problems involved in radiation of plastics are discussed in detail.

"A New Look at Nylon Plastics," M. W. Riley, *Materials Design Eng.*, 48, 7, 94 (Dec. 1958).

A brief review of the current status for nylon materials, including their comparative properties with other high-impact thermoplastics.

"Organic Pigments for Coloring Synthetic Resins," G. M. Reiner, *Materie Plastiche*, 23, 11, 923 (Nov. 1957).

For satisfactory coloring of synthetic resins, organic pigments must meet a variety of requirements. In addition to the plastic itself, the fillers and processing methods must be considered. The pigments suitable for urea, melamine and phenolformaldehyde, polystyrene, polyethylene and PVC are discussed. The lightfastness, thermal resistance and compatibility of a number of pigments for these plastics are shown in tabular form. (In Italian.)

"Low Viscosity Casting Resins Based on Epoxide Compounds," H. Jahn, *Plaste u. Kautschuk*, 4, 12, 457; 5, 1, 6 (Dec. 1957 & Jan. 1958).

Methods of preparing low-viscosity epoxy-type casting resins, and their processing and properties are discussed. Various applications of cold- and hot-curing types that have been developed in East Germany for the electrical field, and as embedding material for scientific purposes, are described. (In German.)

"Surface Erosion of Filled Plastics," S. B. Newman, S. D. Toner and B. G. Achhammer, *Modern Plastics*, 36, 4, 135 (Dec. 1958).

Test results are given for various glass-reinforced laminate specimens exposed to 50 cycles of washing with a hot detergent solution, rinsing, and drying.

"Foam Stability," A. J. de Vries, *Plastica*, 11,1, 40 (Jan. 1958).

In principle, all liquid foams are unstable, but the rate at which structural changes occur depends on a number of parameters. Structural changes may be due to transference of gas molecules, as well as rupture of the film surrounding the gas bubbles in a liquid foam. The conditions under which these two processes can be reduced to a minimum are explained, special attention being drawn to the influence of the presence of surface-active substances on gas diffusion in liquid foams. (In Dutch.)

"Akulon," J. Siebrand, *Australian Plastics*, 13, 148, 9 (Nov. 1957).

The production of Akulon (or Caprolactam Nylon 6) and the properties of the various types of Akulon, including the newer thermoplastic Nylon 6/6, are briefly described, as are the processing methods.

"Hydrogenated Polybutadienes as Bonding Agents for Plastics and Metals," D. Wright and N. Parkman, *Brit. Plastics*, 31, 6, 255 (June 1958).

Results are reported of tests in bonding plastics and metals with hydrogenated polybutadienes, as carried out for the Electrical Research Association, Leatherhead, England. It was shown that metals and plastics can be bonded at 85° C. with no effect on the shape of the bonded plastic. Brass, aluminum, high- and low-density polyethylene, Neoprene, unfilled epoxide, bonded (but not plasticized) PVC, and PTFE were employed.

"Polyethylene," A. Schwartz, *Kunststoffe*, 48, 7, 282 (July 1958).

The properties of polyethylene and the differences between the various new types of polyethylene now being produced, are best understood when the structure of the individual molecule and the arrangement in molecular association are known. The author begins by discussing these two factors and their relationships. Next, the factors of crystallinity and temperaure, specific gravity, mechanical properties, gas permeability, and the relationship of mechanical and chemical properties to molecular weight are discussed. Finally, stress-cracking and stabilization to heat and light are covered. (In German.)

"Experiments on Polyester-Fiber Glass Compounds," B. Bossu, *Ind. Plastiques Mod.*, 10, 7, 27 (July-Aug. 1958).

The properties of glass-reinforced polyester moldings are affected not only by the nature and proportion of the different components, but also by the mixing process and molding conditions. These factors are all considered in the present study. (In French.)

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Equipment

"Packaging Machinery Advances for Polyethylene Films," S. A. Zerbe, *SPE J.*, 14, 11, 26 (Nov. 1958).

Recent developments in automatic packaging machinery are described.

"How to Speed Up Older Injection Machines," A. R. Morse, *SPE J.*, 14, 12, 27 (Dec. 1958).

Some suggestions for achieving faster, more efficient operation from older machines.

"Screw Preplasticization in Injection Molding Machines," P. Korda, *Ind. Plastiques Mod.*, 10, 6, 24 (June 1958).

Some recent injection machines with screw plasticization are reviewed and the advantages of the design of a certain German machine particularly are considered. (In French.)

"Ejectors Retracted in the Open Position of Injection Molds," H. Spies, *Plastverarbeiter*, 11, 11, 414 (Nov. 1957).

It frequently is desirable that the ejector return to its original position immediately after the mold is opened and after the ejecting stroke has been completed (for instance, when metal screws pins, ect., must be inserted in the mold. or thread cores are used) to provide interior or exterior threads in the molding Two ejecting devices answering the purpose are described. (In German.)

Processing

"Resin-coated Papers," S. Zoccarini, *Materie Plastiche*, 23, 11, 896 (Nov. 1957).

In general terms, the author describes the processes and resins used in coating papers and other materials, either alone or in combination with cellophane, fabrics, aluminum foil, etc., to produce heat-sealable and moisture-proof or impermeable packagings. Coating by dry and wet methods, as well as by dipping or extrusion, also are discussed. (In Italian.)

"Radiation Processing," T. Bain and W. H. T. Davison, *Trans. Plastics Inst.*, 26, 64, 193 (April 1958). Presented at the Joint Conference of the Institution of the Rubber Industry and the Plastics Institute, London, Feb. 27, 1958.

The beneficial effects of irradiation on silicones, polyesters, rubber and, more especially, on polyethylenes (for which the method seems most advantageous) are described. The commercially interesting types and sources of radiation and the method of employing the two chief kinds of radiation sources (radioactive isotopes and electrical machines) are discussed. At present, the electron accelerators are the only radiation sources readily available in commercial operation, and details are given of radiation processing of polymers, based on a Van de Graaff electron accelerator. Methods of irradiating thin film, insulated cable and wires, and electrical components, are described and output and costs are considered.

"Manufacture of Plastic Keys for Writing Machines at the New Factory of Societe Bellingnite," P. Stuchlik, *Matieres Plastiques*, 4, 41, 82 (Nov. 1957).

This French firm produces a large variety of plastic keys in a wide range of colors for various types of writing machines. This article describes the plastic materials, molds, methods, and injection used in the manufacture of two-color typewriter keys. (In French.)

Applications

"Study of Joints for Polyethylene Tubes," A. Dautheville, *Ind. Plastiques Mod.*, 10, 7, 16 (July-Aug. 1958).

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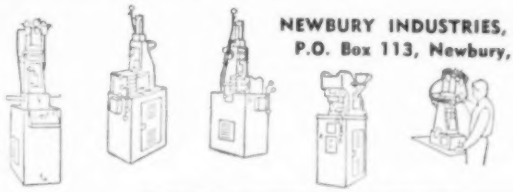

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Tests to determine the mechanical behavior of joints for polyethylene pipe are described, as well as the different types of joints in use. The main points to be considered in evaluating results are indicated. (In French.)

"The Radiography of Polyethylene," D. C. Shotton, *Brit. Plastics*, 31, 6, 249 (June 1958).

Radiography has now found a place as a valuable aid in the testing of polyethylene moldings. After considering the basic principles of X-ray testing, the interpretation of radiographs (the apparatus and the results, the author gives an account of the planning of routine X-ray inspection.

"Sheet Metal Plus Plastics Skinplate." H. Kalpers, *Plastverarbeiter*, 11, 11, 406 (Nov. 1957).

The sheet metal/plastic composite material known in America as Marvibond, is produced by a Belgian form under the name of Skinplate. The properties, fabrication methods and applications are described. (In German.)

"Vinyl Plastic Floorings Applied with a Trowel," L. Simon, *Matieres Plastiques*, 4, 41, 41 (Nov. 1957).

The method of preparing and laying jointless floorings of polyvinyl-acetate emulsions are described. Formulas are given for compositions based on plasticized and unplasticized emulsions, both with or without the addition of Portland cement, besides the usual fillers and pigments. (In French.)

"Insulation of Work Shops with Plastic Foams Produced on the Spot," H. Baumann, *Plastverarbeiter*, 11, 11, 410 (Nov. 1958).

Brief description of the procedure followed in insulating the ceiling of a workshop, 122 x 27 meters, with a urea-formaldehyde resin foam produced on the spot from two liquid components. (In German.)

"Finishing Wood Surfaces with Rigid PVC Sheet," C. Kubitzky, *Kunsstoffe*, 48, 6, 281 (June 1958).

The development of suitable adhesives and bonding processes has made it possible to cover plywood and composition board with rigid PVC to obtain durable, resistant, and colorful surfaces for kitchen furniture and the like is covered. Details are given on the procedure for applying the PVC sheet and finishing curves and corners. (In German.)

"Plastics in the Construction of Chemical Apparatus," W. Pungs, *Kunststoff-Rundschau*, 4, 10, 433 (October 1957).

The plastics chiefly used in the construction of chemical apparatus are rigid and plasticized PVC, polyethylene, poly-isobutylene, acrylics, and polystyrene. After reviewing forming and bonding methods that have been developed for these materials, the author mentions a number of applications, including reaction towers, screw conveyors, filtering apparatus, exhaust installations, slide valves for rigid PVC pipe, gas meters, and cooling coils. (In German.)

"Pointers to the Plastics Contribution to Building," V. H. Wentworth *Brit. Plastics*, 31, 4, 161 (April 1958).

How plastics can be employed for various purposes in the building industry is described with examples drawn chiefly from the United States, but also from Canada and Britain. The limitations of plastics, as well as their advantages, are mentioned. Attention is called to problems that need further work: terminology, lack of comprehensive performance and mechanical data, lack of cost information, and lack of dimensional and quality controls.

Requests for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"Applied Plastics"
The Scientific Press, Ltd.
11 Gloucester Road
London, S.W. 7, England

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

"Australian Plastics"
Australian Trade Publications, Ltd.
171 Sussex St., Sydney, Australia

"British Plastics"
Iliffe & Sons, Ltd.
Dorset House, Stanford St.
London S.E.1., England

"Canadian Plastics"
341 Church St., Toronto, Ont., Canada

"Chemical and Engineering News"
1155 Sixteenth St. N.W.
Washington 6, D.C.

"Hule Mexicano y Plasticos"
Filomeno Mata 13-11, Mexico, D.F.

"Industrial and Engineering Chemistry"
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Washington 6, D.C.

"Industries des Plastiques Modernes"
Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

"Kunststoffe"
Carl Hanser Verlag
Leonard Eck Str. 7, Munich 27,
Germany

"Kunststoff-Rundschau"
Brunke Garrels, Verlagsbuchhandlung
Borgfelder Strasse 83, Hamburg 26,
Germany

"Materials and Design Engineering"
Reinhold Publishing Corp.
430 Park Ave., New York 22, N. Y.

"Materie Plastiche"
Via Farneti 8, Milan, Italy

"Matiéres Plastiques"
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Rue des Fripiers, Brussels, Belgium

"Mechanical Engineering"
American Society of Mechanical Engineers
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"Plastverarbeiter"
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Herxheim b. Landau/Pfalz, Germany

"Poliplasti"
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Milan, Italy

"Revista de Plasticos"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
65 Prospect St., Stamford, Conn.

"Transactions of the Plastics Institute"
6 Mandeville Place, London W. I.
England

Western Plastics
Western Business Publications
274 Brannan Street
San Francisco 7, Calif.

Patent Digest

Materials

Production of Acrylonitrile. No. 2,840,592. E. L. Carpenter, Stamford, Conn. (to American Cyanamid Co., New York, N.Y.)

The catalyst solution is diluted with water, and copper is precipitated as cuprous chloride and cuprous cyanide, while tarry by-products remain in solution. The precipitate is collected without further purification for use as a catalyst.

Nylon Hydrolysis. No. 2,840,606. B. M. Miller, Wilmington, Del. (to E. I. du Pont de Nemours and Co., Wilmington, Del.)

In alkaline hydrolysis of a polyamide, an improvement comprising the addition of an aliphatic alcohol having from 3-8 carbon atoms in the molecule.

Polyamide Resin Composition and Method of Preparing Same. No. 2,840,264. J. H. Groves, Narrington, Ill. (to American Can Co., New York, N.Y.)

Polyamide resin A, which consists of the polyacyl groups of a polymeric fat acid and the polyamino groups of a polyalkylene polyamine having terminal primary amino groups, is reacted with polyamide resin B which consists of the mixed polyacyl groups of a polymeric fat acid, a 3-8 carbon atom dicarboxylic acid free from ethylenic unsaturation, and the diamino groups of an alkylene diprimary diamine. The reaction is carried out at a temperature between 392-450° F., for a time ranging from 1-16 hours.

Compositions of Acrylonitrile Polymers and Ethylene Oxalate and Process for Preparing Same. No. 2,841,568. A. B. Craig and E. L. Rinewald, Decatur, Ala. (to The Chemstrand Corp., Decatur, Ala.)

A homogeneous, miscible mixture of ethylene oxalate, and a polymer of monomeric substances of which acrylonitrile at least 70% of the polymerizable content.

Method for Molding Plastic. No. 2,841,826. M. Brucker, Los Angeles, Calif. (to Zenith Plastics Co., Gardena, Calif.)

After a heated mold is charged with a thermosetting resin, large-area articles are formed by setting one side of the mold for an initial rapid motion to a point just short of the full closed position, and with a force less than that required for final closing. This heats and presses the resin into the mold cavity. The opposite side of the mold is used to complete the closing operation. Force at all times is substantially equal to the required final molding pressure.

Method of Making Hollow Plastic or Rubber Articles. No. 2,839,788. M. Dembiak, Wallington, N.J.

A diaphragm of cured plastic material is placed between each of two adjacent sections of a hollow mold. After placing a liquid, thermosetting plastic in the separated sections, they are clamped together and the whole assembly is rotated so that the liquid plastic coats the entire interior of the mold. Heat is applied during rotation to cure the coating, after which the mold sections are removed from the finished product.

Process for Polymerizing Vinyl Compounds Containing a Basic Nitrogen Atom. No. 2,840,550. J. A. Price, Stamford, and W. M. Thomas, Noroton Heights, Conn. (to American Cyanamid Co.)

A major proportion of acrylonitrile and a minor proportion of vinyl pyridine are polymerized in an aqueous solution containing chlorate ions, sulfoxy ions, and sufficient nitric acid to render the pH between 1-5.

Olefin Polymerization With Catalysts Prepared From Boron Compounds and Transition Metal Compounds. No. 2,840,551. E. Field, Chicago, H. N. Friedlander, Homewood, and O. O. Juveland, Chicago, Ill. (to Standard Oil Co., Chicago, Ill.)

The reaction is carried out in the presence of a catalyst prepared by mixing a boron compound with a polyvalent salt of a metal selected from Groups 4a, 5a, 6a, and 8 of the Mendeleef Periodic Table.

Aryl Phosphate Plasticized Alkyd Resin Adhesive Compositions and Method of Preparing. No. 2,840,535. H. D. Crandon, Woodstock, Conn., and T. E. Burgess, Southbridge, Mass. (to American Optical Co., Southbridge, Mass.)

A transparent, water-resistive cement, for joining transparent elements consisting of a polymer of diethylene glycol and maleic acid, cross-linked with diallyl phthalate. The resin is plasticized with a hydrophobic aryl compound.

Thermoplastic Compositions of Water-Soluble Cellulose Ethers. No. 2,840,485. G. K. Greminger, Jr., Midland, and M. A. Weaver, Ithaca, Mich. (to Dow Chemical Co., Midland, Mich.).

The composition consists of 5-80% of a water-soluble cellulose ether in which the alkyl group contains from 1-3 carbon atoms and the hydroxyalkyl group contains from 2-3 carbon atoms, and from 95-20% of an alkyl glycolate whose alkyl group contains from 1-4 carbon atoms.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Equipment

Pressurized Cooling Trough for Extruders. No. 2,837,764. Cecil A. Hallam, Westfield, and Samuel Pitt, Cranford, N. J. (to Western Electric, Inc., New York, N. Y.).

The closed trough is disposed in a horizontal plane to surround the plastic which is being extruded onto a core. The exit end of the trough is sealed about the sheathed core, and there is a means for controlling the flow and depth of water. Openings receive excess water overflowing this dam, and air is used to force the plastic sheath onto the core.

Knockout Mechanism for Molding Machine. No. 2,837,765. Wilfred G. Harvey, Leominster, Mass.

The ejector mechanism is mounted on the movable platen which holds the mold and two-stage stripper mechanism. The stripper effects first-stage stripping, and the ejector is depressed to effect the second stage.

Polymerization Apparatus. No. 2,838,380. Leonard Kean, New York, N. Y. (to Minnesota Mining & Mrg. Co., St. Paul, Minn.).

The vessel has a plurality of partitions positioned in the bottom, but in open communication at the top. A hollow, rotatable shaft is common to all the sections and bears a hollow blade which conforms to the shape of the vessel. The blade, which functions as a scraper, has a plurality of holes directed towards the vessel wall and a means connecting the orfices with the channel in the hollow shaft.

Film Advancing Roll. No. 2,839,785. W. H. Stevens, Nashville, Tenn. (to E. I. du Pont de Nemours and Co., Wilmington, Del.)

In an apparatus for simultaneous multi-sheet casting of regenerated cellulose film,

an improvement in which the film advancing rolls are provided with two spiral surface grooves of equal and opposite pitch. The spiral grooves start at the center of the roll and lead toward its opposite edges. A plurality of longitudinal grooves are spaced about the roll periphery. All grooves are sufficiently wide and deep to permit deformation therein of the wet film.

Method of and Apparatus for Making Polyurethane Foam Coated Fabrics. No. 2,841,205. Whitworth F. Bird, Riverside, Conn. (to Collins & Aikman Corp., Philadelphia, Pa.)

Mechanically driven conveyor belts are arranged to advance the fabric from the feed- to the discharge-end. A dispenser for the polyurethane foam components, a means for curing the product, and a splitting device for splitting the cured foam are defined.

Rotary Type Machine for Granulating Polystyrene Pellets. No. 2,841,341. A. E. Noble, Plainfield, and Charles F. Anness, Jr., Sewaren, N.J. (to Catalin Corp. of America, New York, N.Y.)

This machine comprises a blade-bearing rotor which revolves within a stator whose inner surface is provided with teeth. The teeth and blades work in a shear-relationship for reducing the pellets. The pellets are fed into the top, and the granulated material discharged from the bottom.

Spinnerets for Melt-Spinning High Polymeric Substances. No. 2,839,783. W. de Wolf, Arnhem, Netherlands. (to American Enka Corp., Enka, N.C.)

The spinneret has a body of stainless steel. The conical holes, through which the polymeric substance is spun, are fitted with inlays of an alloy consisting of 70% gold and 30% platinum.

Compression Molding Apparatus. No. 2,839,786. John A. Alesi, West Los Angeles, Calif.

The base incorporates a mold cavity, a feed tray at its front end, and a pair of horizontal rails which extend from its rear. The feed tray has a pair of sidewardly-extending shafts with a roller and cam wheel on each. Additional rollers, mounted on each side of the feed tray, ride on the horizontal rails. A male die carrier moves vertically with respect to the base and carries a pair of vertical cam plates which mate with the wheels to effect a horizontal movement of the tray between its charging position and its retracted position. An ejection chute, which is normally in a forwardly and downwardly inclined position, is pivoted from the front end of the feed tray. A means is provided to maintain this chute in its normal position.

Feed Mechanism for Injection Molding Machine. No. 2,841,824. W. G. Harvey, Leominster, Mass.

Thermoplastic materials are intermittently fed, in predetermined charges, to the injection cylinder. The resins are contained in a supply hopper which communicates with the cylinder feed opening through a vertical delivery duct. A closure member is mounted on the outside of the cylinder where its lower portion projects into the feed cylinder and conforms with its inner curvature. The closure member is supplied with means for moving it from a fully opened to a fully closed position.

Method and Apparatus for Measuring Viscosity, etc., of Fluid-Like Materials. No. 2,839,915. W. Roth and S. R. Rich, West Hartford, Conn. (to Bendix Aviation Corp., New York, N.Y.)

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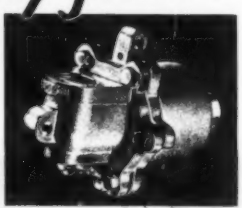

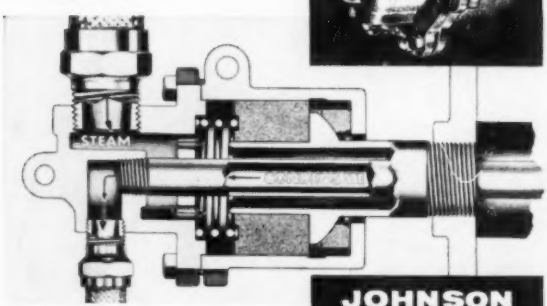

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tion is in shear with the contacting fluid. The electrical measuring device measures variations in the oscillation's rate of attenuation.

Method and Apparatus for the Production of Filament. No. 2,839,784. H. Weber, Bloomfield, and W. D. Paist, Berkeley Heights, N.J. (to Celanese Corp. of America, New York, N.Y.)

A chamber for receiving particles of fusible, filament-forming material communicates with a heated spinning jet. A plurality of reciprocating rams within the chamber exert a mechanical pressure against the material. The driving mechanism is arranged so that at least one ram will exert a pressure throughout the entire cycle, while the remainder will exert simultaneous pressures throughout a major portion of the cycle.

Applications

Floor Coverings Comprising Polyethylene Terephthalate Film. No. 2,836,528. Carlton Dudley Ford, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

The composite sheet structure consists of a top layer of reverse-printed, biaxially-oriented, balanced, heat-set polyethylene terephthalate film; an intermediate, adhesive layer of butadiene-acrylonitrile copolymer; and a bottom layer of asphalt-impregnated felt.

Resins and Use Thereof. No. 2,835,107. John M. Ward, Westfield, N. J. (to Haveg Industries, Inc., Wilmington, Del.).

The application here is a rocket with lined discharge end. This lining consists of inorganic fibers oriented in a direction circumferential of the liner, plus a thermosetting resin.

Flexible Nylon Tube and Method for Preparing Same. No. 2,836,181. James S. Tapp, Decatur, Ala. (to Chemstrand Corp., Decatur, Ala.).

The device is intended as a non-kinking, non-collapsing blood vessel replacement. It consists of a braided nylon tube stiffened by treatment with a formic acid solution, and has mechanically-induced circular crimp which is rendered permanent by heat treatment. The crimp is later relaxed by hot water treatment, and the tube is dried.

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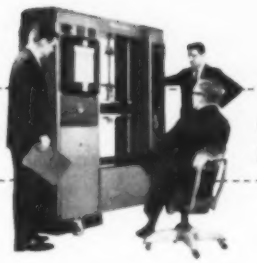

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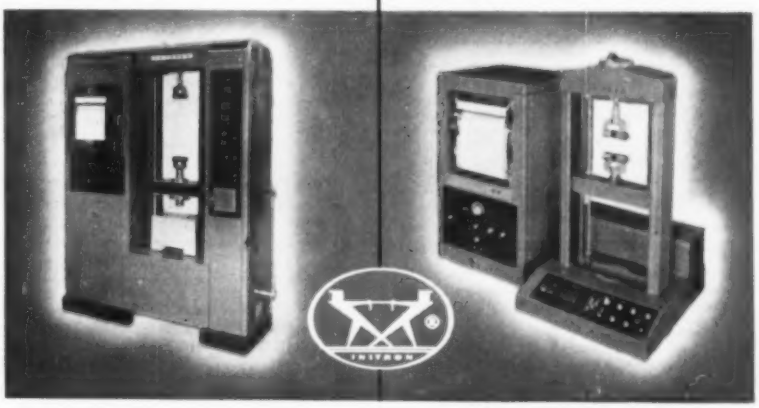

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515	lb.	.75	/	.785
520	lb.	.575	/	.5825
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Black	lb.	.40	/	.445
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Grex, nat.	lb.	.38	/	.42
General purpose black	lb.	.405	/	.445
Colors and special purpose black	lb.	.44	/	1.01
Hi-fax, nat	lb.	.38	/	.42
Colors	lb.	.44	/	1.01
Electrical grade, nat	lb.	.38	/	.42
Colors	lb.	.46	/	1.03
Monofilament, nat	lb.	.38	/	.42
Colors	lb.	.44	/	1.01
Marlex, types 2, 9, 15, 35, 50:				
Black, general purpose	lb.	.405	/	.445
High dispersion and plain	lb.	.44	/	1.01
Natural	lb.	.38	/	.42
Super Dylan, black	lb.	.405	/	.47
colors and nat	lb.	38	/	.42

CALENDAR of COMING EVENTS

Feb. 18-20
ASTM Committee D-20. Sheraton Park Hotel, Washington, D.C.

March 4
SPE Western New England Section. End User's Night. Bradley Field, Terrace Dining Room, Windsor Locks, Conn.

March 10
SPE Baltimore-Washington Section. Plastics in Packaging. Rolling Inn, Baltimore, Md.

March 17-19
Exhibit and 15th Annual Conference of National Association of Corrosion Engineers. Sherman Hotel, Chicago, Ill.

March 26-27
SPI 16th Pacific Coast Section Conference. Hotel Del Coronado, Calif.

April 20-21
SPI 17th Annual Canadian Section Conference. Windsor Hotel, Montreal, Can.

April 29-30
Manufacturing Chemists' Association, Inc. Packaging and Transportation of Chemical Products. Engineering and Scientific Center, Cleveland, O.

May 7
SPE Pittsburgh Section RETEC. Plastics and the Metals Industry. Penn-Sheraton Hotel, Pittsburgh, Pa.

In Brief . . .

Hamilton Division, Baldwin-Lima-Hamilton Corp. has appointed seven new distributors of its line of mechanical and hydraulic presses in Michigan, Ohio, Alabama, Florida, Texas, and Virginia. Addy & Luby Machinery Co., Detroit, Mich., will handle most of Michigan; Anscheutz Machinery Co., Hamilton, O., will cover parts of Ohio, Indiana, and Kentucky; McVoy-Hausman Co., Birmingham, Ala., will sell in Alabama, parts of Florida, Mississippi, and Tennessee; General Equipment, Inc., Miami, Fla., will cover southern Florida; Selby-Horan Machine Tools Co., Houston, Tex., will handle southern Texas; Hamilton Machinery Co., Dallas, Tex., will be responsible for northern Texas; and Tidewater Supply Co., Inc., Norfolk, Va., will sell in Virginia and North Carolina.

A new sales territory consisting of Georgia, South Carolina, and northeast Florida has been established for the Georgia distributor, Frank O. Walsh, Jr., of Atlanta.

Domestic Production and Sales of Plastics and Resin Material, September and October, 1958

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of September and October, 1958. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Although cellulosics and phenolics have gained over last month, they remain slightly below last year's totals. Polyethylene continues about the same and is 25% higher than last year. Styrenes, vinyls, as well as urea and melamine resins are up 10–12%; and miscellaneous materials are holding steady. Grand totals are about 10–12% higher than in 1957.

	September, 1958		October, 1958	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,295,395	1,428,001	1,238,322	1,368,595
Sheets, 0.003 gage and over	1,715,861	1,820,271	1,619,819	1,640,825
All other sheets, rods, and tubes (including other cellulose plastics)	936,064	771,295	858,076	899,831
Molding and extrusion materials (including other cellulose plastics)	8,215,166	8,066,521	10,034,892	9,807,662
Nitrocellulose sheets, rods, and tubes	222,925	206,354	270,874	276,885
TOTAL	12,385,411	12,292,442	14,022,583	13,993,798
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	15,341,168	15,387,931	18,684,934	16,898,405
Bonding and adhesive resins for—				
Laminating (except plywood)	6,615,326	4,637,884	7,336,092	3,746,979
Coated and bonded abrasives	1,060,849	1,016,382	1,411,309	1,284,445
Friction materials (brake linings, clutch facings, and similar materials)[7]	1,337,477	1,320,739	1,613,084	1,316,758
Thermal insulation (fiber glass, rock wool)	4,375,947	4,327,396	4,203,023	4,394,325
Plywood	5,041,439	4,401,370	5,386,997	4,274,479
All other bonding and adhesive uses	3,161,788	3,281,772	4,149,664	4,121,678
Protective-coating resins unmodified and modified except by rosin	2,557,256	2,207,427	2,930,203	2,346,321
Resins for all other uses	2,965,743	2,584,126	3,420,098	3,678,938
TOTAL	42,456,993	39,165,027	49,135,404	42,062,328
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,981,417	2,846,488	3,846,488	3,116,703
Paper-treating and paper-coating resins	2,349,353	2,220,682	2,496,651	2,239,189
Bonding and adhesive resins for—				
Laminating	3,461,175	2,835,372	3,451,623	2,739,883
Plywood	10,404,249	9,917,990	10,440,471	10,761,970
All other bonding and adhesive uses	894,240	947,705	1,210,525	1,179,529
Protective-coating resins, straight and modified	3,196,907	2,657,850	4,020,549	2,727,930
Resins for all other uses, including molding	8,211,910	7,796,310	9,044,602	9,489,725
TOTAL	31,499,251	29,222,397	34,115,066	32,254,929
Styrene Resins:				
Molding materials[1]	40,361,199	41,122,376	43,733,325	46,285,773
Protective-coating resins, straight and modified	8,289,579	8,033,818	9,019,816	8,460,996
Resins for all other uses	14,895,900	12,051,772	15,119,966	12,308,535
TOTAL	63,546,678	61,207,966	67,873,107	67,055,304
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		6,696,335		7,357,973
Sheeting (resin content)		6,971,370		6,974,733
Molding and extrusion (resin content)		20,028,835		23,988,939
Textile and paper treating and coating (resin content)[3]		6,193,596		7,115,805
Flooring (resin content)		10,339,630		11,554,784
Protective coating (resin content)		2,369,749		2,528,361
All other uses (resin content)		7,235,936		8,580,297
All other vinyl resins for—				
Adhesives (resin content)		4,308,407		4,859,006
All other uses (resin content)		11,348,841		13,560,494
TOTAL	82,133,434	75,492,699	88,551,120	86,520,392
Coumarone-Indene and Petroleum Polymer Resins	20,492,188	20,225,594	24,105,681	24,204,742
Polyester Resins:				
For reinforced plastics	7,336,557	7,143,861	9,293,720	8,301,693
For all other uses	1,393,852	1,442,215	3,139,592	1,607,659
TOTAL	8,730,409	8,566,076	12,433,312	9,909,352
Polyethylene Resins:				
For film		25,421,412		30,045,499
For all other uses		59,736,295		54,084,560
TOTAL	75,252,302	85,157,707	79,308,587	84,130,059
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding Materials[1, 4]	4,229,010	4,560,819	5,033,274	4,859,282
Protective-coating resins[5]	2,117,111	705,041	2,005,854	705,429
Resins for all other uses[6]	11,587,173	10,959,125	14,353,192	13,093,212
TOTAL	17,933,294	16,224,985	21,392,320	18,657,923
GRAND TOTALS	354,429,960	347,554,893	390,937,180	378,788,827

[1] Includes fillers, plasticizers, and extenders.
[2] Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3] Includes data for spreader and calendering-type resins.
[4] Includes data for acrylic, nylon, silicone, and other molding materials.
[5] Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7] Included with "All other bonding and adhesives uses."
SOURCE: United States Tariff Commission, Chemical Division.

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